

# *Caloptilia* leaf-miner moths (Gracillariidae) of South-East Asia

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**SYNOPSIS.** The South-East Asian species of *Caloptilia* Hübner are reviewed and revised. Twenty-six species are recognised, nine of them new. The pest species *C. theivora* (Walsingham), the tea leaf-roller, and *C. soyella* (Deventer), the soya-bean leaf-roller are included. The latter species is frequently confused with *C. acrotherma* (Meyrick) and *C. prosticta* (Meyrick), similar bean pests which do not occur in South East Asia; notes for the separation of the three species are given. Four species are relegated to synonymy. Keys to adults are provided, with illustrations of adult moths and male and female genitalia.

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## INTRODUCTION

*Caloptilia* are small, often attractively coloured moths which, with species of *Acrocercops* Walengren, constitute the majority of Gracillariidae encountered in South East Asia. The larvae are leaf-miners in their early instars, later feeding externally and concealing themselves within a roll or fold of leaf. The range of larval host-plants of *Caloptilia* is surprisingly wide (see below) and the genus includes several pest species. They are

comparatively primitive ditrysian moths; the characteristics and systematic position of the Gracillariidae have been discussed by Robinson (1988) and Minet (1991).

Adult *Caloptilia* have the characteristic resting-posture of most other Gracillariinae. The wings are rolled around the body, the anterior end of which is lifted well away from the substrate on the long, spindly legs. The body is inclined at an angle of about 45° such that the wing apices almost touch the substrate.

*Caloptilia* has a worldwide distribution but its

diversity is difficult to assess as its definition was restricted recently (Kumata, 1982; and see below) to exclude those species attributable to *Gracillaria* Haworth; some checklists or monographs may deal with *Caloptilia sensu lato*. Coverage is by no means exhaustive, but recorded numbers of species for particular countries or regions are: Britain — 13 (Emmet *et al.*, 1985); France — 16 (Leraut, 1980); North America — 62 (Davis, 1983); Neotropical Region — 17 (Davis & Miller, 1984); Southern Africa — 24 (*Caloptilia sensu lato*) (Vári & Kroon, 1986); Madagascar — 3 (Viette, 1990); Japan — 51 (Kumata, 1982); China — 39 (Liu & Yuan, 1990); New Guinea — 3 (Diakonoff, 1955); New Zealand — 6 (Dugdale, 1988); Marquesas Is — 2 (Clarke, 1986). *Caloptilia* has not been recorded from the Philippine Is (Diakonoff, 1968). The Natural History Museum Microlepidoptera index, which covers the world's species, contains 326 valid names in *Caloptilia*; the index is updated to 1982 and includes in *Caloptilia* those species now attributable to *Gracillaria* as well as numerous taxa that were described long ago as *Caloptilia* or *Gracillaria* and which may now be referable to other genera.

In this paper we review and revise 26 species of *Caloptilia* from South-East Asia. We are aware of another 29 species from this area, probably all undescribed taxa, which are each represented by just single examples, or by damaged and defective specimens, and which cannot therefore be characterised adequately. A further 12 species, apparently endemic to Sulawesi, were collected by participants in Project Wallace in 1985; these are excluded as being extralimital.

## MATERIAL, METHODS AND CONVENTIONS

For the purpose of this paper, we define South-East Asia as comprising southwestern China (areas of Yunnan close to the Burmese border), Burma, Thailand, Laos, Cambodia, Vietnam, West Malaysia (Malaya), East Malaysia (Sarawak, Sabah), Singapore, Brunei, Indonesia west of Wallace's line (Sumatra, Java, Bali, Kalimantan) and the Philippine Islands. In practice, we have seen significant numbers of specimens from only Thailand, Malaysia and Brunei. These were mostly collected by staff (G.S. Robinson, K.R. Tuck, M.A. Tobin) and associates (M.G. Allen, J.D. Bradley) of The Natural History Museum, London from 1981 to date.

Terminology and conventions are compatible with those used by Kumata (1982). Permanent preparations of genitalia were made using the protocols described by Robinson (1976), stained with mercurochrome and mounted in Euparal. Size measurements given are the wingspan of specimens set in conventional fashion.

## Abbreviations

- BMNH — The Natural History Museum, London, UK.  
 EIHU — Entomological Institute, Hokkaido University, Sapporo, Japan.  
 GR — Grid reference, Netherlands East Indies Grid, 1:50,000 map series (Brunei).  
 IZAS — Institute of Zoology, Academia Sinica, Peking, P.R. China.  
 LP — (Helicopter) landing pad, 1: 50,000 map series (Brunei).  
 NP — National Park.  
 RNH — Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.

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The new species *Caloptilia baringi*, *nomurai* and *dicamica* described below are named in recognition of the Baring Foundation, Nomura-NIMCO and DICAM, corporate patrons of the Universiti Brunei Darussalam/Royal Geographical Society Brunei Rainforest Project 1991-2.

## *CALOPTILIA* Hübner, 1825

*Caloptilia* Hübner, [1825]: 427. Type-species: *Tinea upupaepennella* Hübner, 1796: 68, pl. 3,

fig. 203, by subsequent designation by Fletcher, 1929: 38.

*Poeciloptilia* Hübner, [1825].

*Ornix* Kollar, 1832.

*Ornix* Treitschke, 1833.

*Coriscium* Zeller, 1839.

*Antiolopha* Meyrick, 1894.

The following are currently recognised as subgenera within *Caloptilia*:

*Timodora* Meyrick, 1886; *Sphyrophora* Vári, 1961; *Povolnya* Kuznetsov, 1979; *Phylloptilia* Kumata, 1982; *Rhadinoptilia* Kumata, 1982; *Minyoptilia* Kumata, 1982; *Cecidoptilia* Kumata, 1982.

For full bibliographic citations of the genus-group names above and their type-species, see Nye & Fletcher (1991).

**ADULT.** Head and face smooth-scaled; antenna as long as forewing, most species with sparse antennal pecten; haustellum well developed. Labial palpus long, upturned, smooth; second segment slightly rough-scaled beneath, very rarely tufted; third segment as long as or longer than second segment, pointed. Maxillary palpus about three-quarters length of second segment of labial palpus, smooth, porrect or slightly ascending. Legs smooth; fore tibia slightly roughened, mid femur and mid tibia strongly roughened and sometimes thickened beneath with projecting scales; hind tibia smooth and slender, very rarely with rows of very short suberect spine-like scales dorsally (very conspicuous in *leucolitha*); tarsus 1.5 to 2.0 x length of tibia. Fore wing lanceolate, apex somewhat blunt; venation with M2 and M3 free, connate or short-stalked, 1A+2A simple, fused for their entire length. Hind wing half to three-quarters width of fore wing, lanceolate, cell open between M2 and M3, M1 and M2 stalked, 2A usually present; cilia three times width of wing.

**GENITALIA** ♂. Tegumen simple, rarely strongly sclerotized or with a pair of peniculi. Subscaphium usually present. Seventh and eighth abdominal segments membranous, usually with one pair of coremata each (but in *baringi* only 7th segment with coremata, and in *selimpat* and *teucra* only 8th segment with coremata). Seventh sternite a narrow sclerotized bar, with in most species a slender medial apodeme directed caudad. Eighth tergite usually sclerotized, a small fan-shaped sclerite with a narrow medial ridge.

**GENITALIA** ♀. Ostium bursae usually situated intersegmentally between seventh and

eighth sternites (in *dogmatica*, *hemiconis* and *soyella* it is within the eighth sternite). Seventh abdominal segment usually similar to the anterior segments (but much more strongly sclerotized in *soyella* and *acinata*). Corpus bursae usually with a pair of signa, rarely with a single signum (*theivora* and *nomurai*).

**DISTRIBUTION.** The species treated here are predominantly inhabitants of hill forest, and of lower and upper montane forest. Seventeen of the 22 species for which we have altitudinal data have been found only above 400 m; of these, six (*emas*, *baringi*, *dicamica*, *aeolospila*, *jelita* and *selimpat*) occur only above 1100 m. *C. aeolospila* and *jelita*, from 2000 and 3200 m, have close undescribed relatives occurring at similar altitudes in Nepal. The remaining five species have lowland distributions and have been recorded from localities from 750 m down to sea level.

Few conclusions can be drawn from the distribution patterns described below, as so few specimens of each species are known. Endemicity may be apparent rather than real, a function of under-collection. One species is restricted to Thailand, four to peninsular Malaysia, one to Brunei and three to Java. Six of the seven Bornean species occur also in peninsular Malaysia or Thailand, and four of the six are also in Sulawesi. Only nine of the eighteen species occurring in Thailand and/or peninsular Malaysia have distributions that extend further south and east to Java or Borneo.

**BIOLOGY.** Like all Gracillariidae, the larvae of *Caloptilia* are hypermetamorphic. The first two instars are phloem-feeding leaf-miners; subsequent instars feed on leaf tissue, at first internally and later externally. In the first instar the larva mines a gallery that is expanded into a blotch mine by the second instar. Following hypermetamorphosis at the second ecdysis, the larva continues to feed internally, removing parenchyma from within the blotch mine. This phase of growth occupies a variable number of instars; in *Caloptilia stigmatella* (F.) it is just one (Kumata, 1978). Following this, the larva feeds externally and conceals itself within a roll or fold of the leaf; the larva of *stigmatella* spends two instars as an external-feeder. However, members of the subgenera *Rhadinoptilia*, *Minyoptilia* and *Cecidoptilia* are leaf-miners for the whole of the feeding phase of the larva and only leave the mine to pupate (Kumata, 1982). In *Cecidoptilia* the mine develops into a gall as the larva feeds and the larva pupates within the gall.

*Caloptilia* species have been reared from a



wide range of plant families. However, individual species appear to be strongly host-specific, feeding on a very restricted range of plants, often those of only one genus; an exception noted below is *protiella*, recorded from Anacardiaceae and Burseraceae.

Pupation occurs in a silk cocoon concealed within the rolled or folded leaf or away from the final feeding site, often on the underside of the leaf. The pupa is protruded from the cocoon prior to eclosion. A detailed review of gracillariid biology (including *Caloptilia*) is given by Emmet, Watkinson & Wilson (1985), based on a number of European species, and Kumata (1982) has brought together details of the biology of the Japanese *Caloptilia* and allied genera. Kumata (1978) has reviewed the biology and larval transformations of a range of Gracillariidae.

**REMARKS.** *Caloptilia* is one of the largest genera of Gracillariidae and has a worldwide distribution (Kumata, 1982). Prior to Kumata's (1982) paper, *Caloptilia* encompassed also the species now placed separately in *Gracillaria* Haworth; the latter genus was treated as a synonym or subgenus of *Caloptilia*, following Vári (1961). Kumata redefined *Gracillaria* to include those species in which the pregenital segments of the male abdomen are characterised by the 7th being unmodified and resembling the preceding segments, and the 8th being membranous with a pair of coremata; the 8th segment is covered with sparse scales of a type similar to those of the preceding segments. The restricted definition of *Caloptilia* includes now those species in which both the 7th and 8th abdominal segments are membranous, each with a pair of coremata, and devoid of scales or with sparse specialised scent-scales. As a generalisation, females of *Caloptilia* have two signa while females of *Gracillaria* have only one. Unless the latter characteristic can be interpreted as a synapomorphy of *Gracillaria* species, the suspicion must be that *Caloptilia* is an in-group of (paraphyletic) *Gracillaria*.

Of the genus-group names listed here under the synonymy of *Caloptilia*, Kumata (1982) has recognised the last eight, with the exception of *Antiolopha*, as subgenera of *Caloptilia*. We have not formally utilised subgeneric divisions in this paper but, using Kumata's definitions, it is possible to attribute the species below to subgenera with five exceptions. The first twelve (*theivora* to *aurifasciata*) are referable to the nominotypical subgenus *Caloptilia*; *syrphetias* is a *Phylloptilia*; *acinata*, *protiella* and *iselaea* are *Timodora*; *dicamica* is a *Rhadinoptilia*; *aeolospila* and *jelita* are *Povolnya*. We cannot unequivocally attribute

*scaeodesma*, *selimpat*, *teucra*, species A or *leucolitha* to existing subgenera. The referral of *leucolitha* to *Caloptilia* is debatable. The placing of *scaeodesma* between *Caloptilia* (*Caloptilia*) and *Caloptilia* (*Phylloptilia*) is for curatorial convenience and reflects its phenetic affinities to species of *Phylloptilia*.

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## CHECKLIST OF S.E. ASIAN SPECIES OF CALOPTILIA

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### *CALOPTILIA* Hübner, 1825

#### Subgenus *Caloptilia* Hübner, 1825

- theivora* (Walsingham, 1891)  
*nomurai* sp. n.  
*dogmatica* (Meyrick, 1908), comb. n.  
*sphenocrossa* (Meyrick, 1934), comb. n.  
*etiolata* sp. n.  
*flavida* Liu & Yuan, 1990  
*ariana* (Meyrick, 1914), comb. n.  
*heliciae* Kumata, 1966, syn. n.  
*emas* sp. n.  
*baringi* sp. n.  
*iorphna* (Meyrick, 1939), comb. n.  
*tangkai* sp. n.  
*hemiconis* (Meyrick, 1894)  
*rhaptocrossa* (Meyrick, 1932), syn. n.  
*soyella* (Deventer, 1904)  
*aurifasciata* Kumata, 1982

#### Unattributed to subgenus

- scaeodesma* (Meyrick, 1928), comb. n.

#### Subgenus *Phylloptilia* Kumata, 1982

- syrphetias* (Meyrick, 1907), comb. n.  
*zopherotarsa* (Meyrick, 1936), syn. n.  
*perseella* Kumata, 1982, syn. n.

#### Subgenus *Timodora* Meyrick, 1886

- acinata* sp. n.  
*protiella* (Deventer, 1904), comb. n.  
*corollata* (Meyrick, 1933)  
*elongata* Kumata, 1982, syn. n.  
*iselaea* (Meyrick, 1914), comb. n.  
*hapalocharis* (Meyrick, 1935), syn. n.



Subgenus *Rhadinoptilia* Kumata, 1982*dicamica* sp. n.Subgenus *Povolnya* Kuznetzov, 1979*aeolospila* (Meyrick, 1938), comb. n.*jelita* sp. n.

## Unattributed to subgenus

*selimpat* sp. n.*teucra* (Meyrick, 1933), comb. n.

sp. A

*leucolitha* (Meyrick, 1912), comb. n.first tarsomere with dorsal rows of short, stout projecting setae ..... *leucolitha*

2 Labial palpus with rough apical scale-tuft on ventral surface of second segment, terminal segment smooth-scaled ..... 3

— Labial palpus smooth-scaled (but *hemiconis* with sparse projecting scales on apices of second and third segments) ..... 5

3 Fore wing yellow with complicated pattern composed of white or dark brown fasciae and/or spots (Figs 25, 26); 7th and 8th abdominal segments of male each with a pair of coremata ..... 4

— Fore wing ground colour black, with a broad white transverse band and smaller pale fasciae and spots (Fig. 21); only 8th abdominal segment of male with coremata ..... *selimpat*4 Male genitalia with costo-apical corner of valva acute; ventral margin of valva with row of short, stout setae ..... *aeolospila*— Male genitalia with costo-apical corner of valva obtuse; ventral margin of valva without setae ..... *jelita*

5 Fore wing speckled purple-brown with yellowish white transverse fascia at one-third and small white spot at base of tornus (Fig. 22); 7th abdominal

**KEY TO S.E. ASIAN SPECIES OF  
*CALOPTILIA***

1 Antennal pecten sparse or absent; mid-tibia not thickened by projecting scales or with such scales only on ventral surface; hind tibia and tarsus smooth-scaled ..... 2

— Antennal pecten dense, with more than 15 scales; mid-tibia with elongate projecting scales on dorsal and ventral surfaces; hind tibia and basal half of

**INDEX OF HOSTPLANTS OF S.E. ASIAN *CALOPTILIA***

HOSTPLANT FAMILY	HOSTPLANT	<i>CALOPTILIA</i> SPECIES
ANACARDIACEAE:	<i>Anacardium occidentale</i>	— <i>protiella</i>
ANACARDIACEAE:	<i>Rhus succedanea</i>	— <i>aurifasciata</i> , <i>protiella</i>
ANACARDIACEAE:	<i>Rhus sylvestris</i>	— <i>aurifasciata</i> , <i>protiella</i>
ANACARDIACEAE:	<i>Spondias cytherea</i>	— <i>iselaea</i>
ANACARDIACEAE:	<i>Spondias mangiferae</i>	— <i>iselaea</i>
ANACARDIACEAE:	<i>Spondias pinnata</i>	— <i>iselaea</i>
BURSERACEAE:	<i>Protium javanicum</i>	— <i>protiella</i>
EUPHORBIACEAE:	<i>Bridelia</i>	— <i>teucra</i>
EUPHORBIACEAE:	<i>Flueggea virosa</i>	— <i>species A</i>
LAURACEAE:	<i>Litsea chinensis</i>	— <i>leucolitha</i>
LAURACEAE:	<i>Litsea glutinosa</i>	— <i>leucolitha</i>
LAURACEAE:	<i>Persea thunbergii</i>	— <i>syrphetiäs</i>
LEGUMINOSAE:	<i>Azukia angularis</i>	— <i>soyella</i>
LEGUMINOSAE:	<i>Cajanus cajan</i>	— <i>soyella</i> , <i>sphenocrossa</i>
LEGUMINOSAE:	<i>Glycine max</i>	— <i>soyella</i>
LEGUMINOSAE:	<i>Kummerovia striata</i>	— <i>soyella</i>
LEGUMINOSAE:	<i>Lespedeza cytobotrya</i>	— <i>soyella</i>
LEGUMINOSAE:	<i>Mucuna</i>	— <i>iorphna</i>
LEGUMINOSAE:	<i>Phaseolus calcaratus</i>	— <i>soyella</i>
LEGUMINOSAE:	<i>Phaseolus mungo</i>	— <i>soyella</i>
LEGUMINOSAE:	<i>Soya hispida</i>	— <i>soyella</i>
PROTEACEAE:	<i>Helicia cochinchinensis</i>	— <i>ariana</i>
RHAMNACEAE:	<i>Ziziphus jujuba</i>	— <i>flavida</i>
RHIZOPHORACEAE:	<i>Rhizophora</i>	— <i>scaeodesma</i>
SONNERATIACEAE:	<i>Sonneratia</i>	— <i>scaeodesma</i>
THEACEAE:	<i>Camellia japonica</i>	— <i>theivora</i>
THEACEAE:	<i>Camellia sasanqua</i>	— <i>theivora</i>
THEACEAE:	<i>Camellia sinensis</i>	— <i>theivora</i>

- segment of male without coremata ..... *teucra*
- Fore wing pattern otherwise; 7th abdominal segment of male with coremata ..... 6
- 6 Fore coxa silvery white except at apex; fore wing with crimson streak on dorsum ..... 7
- Fore coxa not white; fore wing without crimson streak on dorsum ..... 9
- 7 Crimson streak on dorsum of fore wing uneven (Fig. 8); posterior coremata of male composed of elongate hair-like scales ..... *emas*
- Crimson streak on dorsum of fore wing straight (Figs 7, 9); posterior coremata of male absent, or spade-shaped and composed of broad scales ..... 8
- 8 Indigo-blue strigulae on dorsal crimson streak of fore wing sparse (Fig. 7); male genitalia with subscaphium slender but distinct; posterior coremata present ..... *ariana*
- Indigo-blue strigulae on dorsal crimson streak of fore wing numerous (Fig. 9); male genitalia without subscaphium; posterior coremata absent .. *baringi*
- 9 Fore wing dark brown or grey, with more than two yellow blotches or fasciae ..... 10
- Fore wing coloured otherwise, or with only one or two large yellow blotches ..... 11
- 10 Fore wing dark brown with purple iridescence, with two fasciae (Fig. 14); male genitalia without tufts of setae on diaphragma; female genitalia with corpus bursae pyriform, without appendix bursae ..... *aurifasciata*
- Fore wing dark grey with faint violet iridescence, with three fasciae (Fig. 15); male genitalia with tuft of setae on either side of diaphragma; female genitalia with corpus bursae short, ovoid, with small appendix bursae ..... *scaeodesma*
- 11 Fore wing dark or light ochre with one or two large and distinct yellow blotches ..... 12
- Fore wing uniformly coloured and without yellow blotches, or with the blotches blurred and indistinct ..... 19
- 12 Fore wing with single yellow blotch covering one-third or less of costa ..... 13
- Fore wing with either a single yellow blotch covering two-thirds or more of the costa, or with two yellow blotches ..... 16
- 13 Fore wing broad, with straight dark line and pale wedge in costal area of cilia (Fig. 4) . *sphenocrossa*
- Fore wing narrow, without dark line and pale wedge in cilia ..... 14
- 14 Fore wing ochre-brown with a single broad triangular yellow blotch occupying one-third or more of the costa ..... 15
- Fore wing uniformly violet-fuscous with a single very narrow elongately triangular yellow blotch occupying one-eighth of costa (Fig. 23) . *species A*
- 15 Large species, wing expanse 10–14 mm; fore wing with triangular yellow blotch on second quarter of costa (Fig. 1); 7th sternite of male with narrow sclerite, 6th sternite with acute and elongate medial invagination; female with single signum in corpus bursae ..... *theivora*
- Small species, wing expanse 7–8 mm; fore wing with triangular yellow blotch on second third of costa (Fig. 3); 7th sternite of male membranous, 6th sternite without invagination; female with two signa in corpus bursae ..... *dogmatica*
- 16 Fore wing purple-brown with pair of yellow costal blotches ..... 17
- Fore wing predominantly yellow with only basal and apical purple-brown markings ..... 18
- 17 Large species, wing expanse 11–15 mm; proximal yellow costal spot only two-thirds length of distal spot (Fig. 17) ..... *acinata*
- Small species, wing expanse 9–10 mm; proximal yellow costal spot of same length as distal spot (Fig. 20) ..... *dicamica*
- 18 Basal one-fifth of fore wing purple-brown from costa to fold (Fig. 2) ..... *nomurai*
- Base of fore wing only dusted with purple-brown at costa (Fig. 6) ..... *flavida*
- 19 Fore wing with diffuse yellow or yellow-brown blotch (Figs 5, 12) ..... 20
- Fore wing uniformly coloured, without diffuse blotch ..... 21
- 20 Fore wing predominantly pale yellow, with conspicuous dark scales at apex (Fig. 5) ..... *etiolata*
- Fore wing predominantly yellow-brown, apex without conspicuously darker scales (Fig. 12) ..... *hemiconis*
- 21 Fore wing dark grey or dark brown ..... 22
- Fore wing paler, ochre-brown or yellowish ..... 23
- 22 Small species, wing expanse 7–9 mm; fore wing dark grey, without strigulae, with sparse black dots along costa (Fig. 10); vinculum of male genitalia without lateral tufts of setae ..... *iorphna*
- Large species, wing expanse 13–17 mm; fore wing dark brown, finely strigulated, costa with numerous small black spots (Fig. 16); vinculum of male genitalia with lateral tufts of setae ..... *syrphetias*
- 23 Fore wing dark, ochre-brown, small spots along costa not including a larger spot at one-half; tegumen of male genitalia without lateral setae or peniculi ..... 24

- Fore wing paler, yellowish green or ochre-yellow, costa with small spots along costa including a larger spot at one-half; tegumen of male genitalia with lateral setae or peniculi ..... 25
- 24 Fore wing conspicuously speckled and strigulated with darker scales (Fig. 11); valva of male genitalia without a diagonal internal ridge ..... *tangkai*
- Fore wing almost uniformly coloured, any speckling restricted to costa, dorsum, and discal area (Fig. 13); valva of male genitalia with diagonal internal ridge from base of costa to ventroapical corner ..... *soyella*
- 25 Fore wing pale yellowish green (Fig. 18); tegumen of male genitalia with lateral row of elongate setae; lamella postvaginalis of female bounded laterally by an oval lobe ..... *protiella*
- Fore wing ochre-yellow (Fig. 19); tegumen of male genitalia with peniculi; lamella postvaginalis of female bounded laterally by infolding of longitudinally rugose surface ..... *iselaeta*

## SPECIES DESCRIPTIONS

### *Caloptilia theivora* (Walsingham, 1891)

(Figs 1, 27, 32, 56)

*Gracilaria theivora* Walsingham, 1891: 49, fig. 1. LECTOTYPE ♀, SRI LANKA ('Ceylon'): Pandaloya, 5.iii.1890 (*Cotes*) (BMNH), here designated [examined].

*Gracilaria theivora*; Watt & Mann, 1903: 228-232, figs 23-25 [biology].

*Gracillaria theivora*; Fletcher, [1921]: 165 [biology].

*Caloptilia theivora*; Issiki, 1953: 425, fig. 1218.

*Caloptilia (Caloptilia) theivora*; Kumata, 1982: 35-37, figs.

ADULT. (Fig. 1) ♂♀, 10.0-14.0 mm. Face brassy yellow; head brown with purplish reflection. Palpi yellow; labial palpus ochre-yellow ventrally, apex brown. Fore and mid leg blackish brown with slight purple gloss, tarsi shining white with brown ring on each segment; hind leg with coxa and femur brassy yellow, femur purplish brown on distal half; hind tibia and tarsus ochre-yellow, with dark apical ring on each tarsal segment; some examples with entire tibia and first tarsal segment brown. Fore wing ochre-brown with purple reflection, evenly covered with ill-defined pale yellow or dark strigulae on almost uniform ground-colour; a single brilliant brassy yellow isosceles-triangular blotch on second quarter of costa and extending to fold where

it is truncated to a greater or lesser extent, a few black scales along costal margin; apical cilia ochre-grey with three black lines.

GENITALIA ♂ (Figs 27, 32). Subscaphium slender, T-shaped at basal extremity. Valva curved, gradually dilating towards apex, with marginal setae especially long and dense at both ventro- and costo-apical corners. Vinculum short, one-third as long as valva. Aedeagus two-thirds length of valva, slightly swollen medially, without cornutus. 7th and 8th abdominal segments devoid of scales, each with one pair of coremata; coremata with elongate hairs, anterior pair very dense and about three times length of posterior pair; medial apodeme of 7th sternite absent; 6th sternite with acute, elongate medial invagination reaching caudal two-thirds of 5th sternite.

GENITALIA ♀ (Fig. 56). Apophyses anteriores similar to apophyses posteriores. Lamella postvaginalis rather small, trapezoidal; lamella antevaginalis absent. Antrum very short; ductus bursae very slender and elongate, entirely membranous; corpus bursae large, ovoid; signum single, elongate, curved, sickle-shaped.

DISTRIBUTION. Sri Lanka, India (Kumata, 1982), China (south) (Liu & Yuan, 1990), Taiwan (Kumata, 1982), Japan (Kumata, 1982), Thailand, W. Malaysia, Brunei.

BIOLOGY. Larvae mining leaves of tea trees: *Camellia japonica* Linn., *C. sasanqua* Thunb. and *C. sinensis* Linn. (Theaceae) (Watt & Mann, 1903; Fletcher, [1921]; Kumata, 1982).

MATERIAL EXAMINED. 1♀, THAILAND: Khao Yai NP, 900 m, 3.ii.1987 (*Allen*) (genitalia slide no. 26796; BMNH); 4♂, W. MALAYSIA: Cameron Highlands, Dunhelen Bungalow and Gunung Brinchang, 1680 and 1980 m, 15-25.viii.1986 (*Robinson*) (genitalia slide no. 26798; BMNH); 1♂, W. MALAYSIA: W. Pahang, Genting Tea Estate, 2000', 22-31.x.1981 (*Tuck*) (BMNH); 3♂, BRUNEI: Bukit Pagon, LP 308, 5520', upper montane forest, 15-20.ii.1982 (*Robinson*) (genitalia slide nos 26799, 27261; BMNH).

DIAGNOSIS. This species is one of very few *Caloptilia* with a single signum in the bursa copulatrix of the female. A feature of the males shared only with *C. nomurai* is the conspicuous invagination of the 6th sternite. See also the diagnoses for *nomurai*, *sphenocrossa* and *dogmatica*.

REMARKS. Kumata (1982) described the trian-



gular yellow blotch on the forewing as 'rather widely truncated on fold'; in the specimens that we have examined the width of the blotch at the fold is variable and it may be very narrow. Two of the sites from which we have specimens are adjacent to or among cultivated tea: Dunhelen Bungalow is on the edge of the Sungei Palas Tea Estate (a working estate from which tea is harvested); Genting Tea Estate is an old estate on which the tea bushes have matured into small trees and become interspersed with secondary forest. However, the occurrence of this species on Bukit Pagon in Brunei, many miles from the nearest cultivation, suggests that it may have host plants among primary forest trees in South-East Asia.

*Caloptilia nomurai* sp. n.

(Figs 2, 33, 57)

ADULT (Fig. 2) ♂♀, 11.0–12.0 mm. Face brassy yellow; head brown with purple reflection. Palpi yellowish white; labial palpus with brown basal segment and more or less brown apex; maxillary palpus with brown patches at base and middle. Fore and mid leg blackish brown, tarsi shining white with a brown ring on each segment; hind leg with coxa and femur brassy yellow, femur purplish brown on distal half, tibia and tarsus light ochre-brown, tibia more or less infuscated above, each tarsal segment with brown apical ring. Fore wing ochre-brown with purple reflection, dorsum ochre-yellow posterior to fold, evenly covered with ill-defined ochre-brown strigulae; an elongate bright ochre-yellow blotch extending from one-quarter to apex of costa, and posteriorly to fold, with series of black dots along costal margin; apex of wing covered by black and ochre-yellow strigulae; cilia around apex of wing ochre-yellow in proximal half, and grey with three black lines in distal half.

GENITALIA ♂ (Fig. 33). Subscaphium slender, broadly T-shaped at basal extremity. Valva strongly dilated apically, with the usual marginal setae especially dense at ventro- and costo-apical corners. Vinculum about three-fifths length of valva. Aedeagus sharply pointed at apex, about twice length of vinculum, without cornutus; ductus ejaculatorius particularly elongate, about three times length of aedeagus. 7th and 8th abdominal segments devoid of scales, each with one pair of coremata; coremata with elongate hairs, anterior pair slightly more than twice length of posterior pair; 7th sternite greatly

reduced, without medial apodeme; 6th sternite with short, broad invagination.

GENITALIA ♀ (Fig. 57). Apophyses anteriores similar to apophyses posteriores. Lamella postvaginalis and lamella antevaginalis absent. Antrum about as long as apophyses posteriores; ductus bursae very long and slender, lined caudally with fine spine-like microtrichia; corpus bursae ovoid; signum single, anchor-shaped.

DISTRIBUTION. Thailand, Brunei.

BIOLOGY. Unknown.

MATERIAL EXAMINED. Holotype ♂, BRUNEI: Bt Bedawan, LP 263, GR 343958, ridge dipterocarp forest, 1700', 20–24.iv.1988 (*Robinson*) (genitalia slide no. 27140; BMNH). Paratypes: 2♂, 1♀, data as holotype (genitalia slide no. 27102 ♀; BMNH); 1♂, THAILAND: Khao Yai NP, 850 m, 10–13.vii.1989 (*Bradley*) (genitalia slide no. 27140; BMNH); 1♀, same data but 750 m, 26.ii.–2.iii.1990 (genitalia slide no. 27141; BMNH); 1♀, same data but 1200 m, 17.iv.1987 (*Allen*) (BMNH).

DIAGNOSIS. *C. nomurai* is closely related to *theivora*, sharing the following characters: fore wing ochre-brown with purple reflection; male with 7th and 8th abdominal segments membranous and devoid of scales (but with coremata), and 6th sternite with invagination; female with a single signum in the corpus bursae. But *nomurai* may be distinguished from *theivora* by: a much broader yellow blotch on the fore wing; in the male genitalia the valva is more dilated apically and the ductus ejaculatorius is much more elongated; in the female genitalia the antrum is longer and the signum anchor-shaped rather than sickle-shaped as in *theivora*.

*Caloptilia dogmatica* (Meyrick, 1908),  
comb. n.

(Figs 3, 34, 58)

*Gracilaria dogmatica* Meyrick, 1908: 830. LECTOTYPE ♀, SRI LANKA ('Ceylon'): Ambulangoda, 4.iii.1907 (*Fletcher*) (BMNH), here designated [examined].

ADULT (Fig. 3) ♂♀, 7.0–8.0 mm. Face yellowish white; head ochre-brown. Palpi white; labial palpus with ochre-yellow apex. Fore and mid leg blackish brown, fore femur yellowish white, tarsi white; hind leg white, femur light brown in distal half, tibia more or less infuscated above, each tarsal segment with light infuscated apical ring. Fore wing light ochre-brown, suffused with

yellow-ochreous on margins posteriorly; three small groups of black scales on dorsum; a broad yellowish white triangular blotch on second third of costa, extending posteriorly to fold, edged laterally with black scales; some ill-defined dark fuscous suffusion towards apex; cilia around apex ochre-brown with three black lines.

**GENITALIA** ♂ (Fig. 34). Subscaphium slender. Valva slender, curved, dilated in apical half, with a row of setae near base; ventral apex rounded and covered with elongate setae. Vinculum moderate, three-fifths length of valva. Aedeagus slender, nearly as long as vinculum, without cornutus. 7th and 8th abdominal segments with sparse scale-covering, sternites membranous, 8th tergite slightly reduced, trapezoidal; each segment with one pair of coremata; coremata with elongate hairs, anterior pair about 1.5 times length of posterior pair.

**GENITALIA** ♀ (Fig. 58). Apophyses anteriores similar to apophyses anteriores, both thickened and somewhat elongated. Ostium bursae situated in centre of 8th sternite. Antrum very short; ductus bursae slender and very long, with 7 coils in anterior half, entirely membranous; corpus bursae moderate, ovoid; with a pair of signa that are symmetrical in position and shape, corniform, slightly curved medially.

**DISTRIBUTION.** Sri Lanka, Thailand.

**BIOLOGY.** Unknown.

**MATERIAL EXAMINED.** 1♀ (paralectotype of *dogmatica*), SRI LANKA ('Ceylon'): Hambantota, 25.xi.1907 (*Fletcher*) (genitalia slide no. 27163; BMNH); 1♂, SRI LANKA ('Ceylon'): Nawalapitiya, 2000' (*Pole*) (genitalia slide no. 27028; BMNH); 1♂, W. THAILAND: Kanchanaburi, Kwai Yai R., 25.iv.1987 (*Allen*) (genitalia slide no. 27283; BMNH).

**DIAGNOSIS.** *C. dogmatica* is closely related to *C. hemiconis* and both may be distinguished from other *Caloptilia* by the following characters: membranous or only very weakly sclerotized 7th sternite, and trapezoidal 8th tergite in males; elongate and thickened anterior and posterior apophyses in females. However, *dogmatica* differs from *hemiconis* in that the fore wing has a bright yellow triangular blotch similar to that of *theivora*. See also the diagnosis for *hemiconis*.

**REMARKS.** The single male specimen from western Thailand is a little darker than specimens from Sri Lanka but otherwise does not differ in any significant respect.

***Caloptilia sphenocrossa* (Meyrick, 1934),  
comb. n.**

(Figs 4, 35, 59)

*Gracilaria sphenocrossa* Meyrick, 1934: 474.  
Holotype ♂, JAVA: Telawa, vii.1933  
(*Kalshoven*) (genitalia slide no. 27164;  
BMNH) [examined].

**ADULT** (Fig. 4) ♂♀, 11.0–13.5 mm. Face brassy yellow; head brown with purple reflection. Palpi brassy yellow; labial palpus with brown dots beneath, the extreme apex black. Fore and mid leg slightly purplish ochre-brown, glossy, tarsi shining white; hind leg with coxa and femur brassy yellow, femur ochre-brown on distal half; hind tibia and tarsus ochre-yellow with indistinct black apical ring on each tarsal segment. Fore wing ochre-brown with purple reflection; a brassy yellow isosceles-triangular blotch on second quarter of costa and extending to fold; blotch with scattered black scales on lateral margins and with one or two black dots on costal margin; cilia around wing apex ochre-grey with three dark ochre-brown lines formed by dark-tipped scales of different lengths, costal area with the innermost line (formed from dense, short scales) very straight, forming the inner border of what appears as a pale wedge-shaped spot but which is a region of narrow and sparse scales; in worn specimens this appears to be a notch in the wing apex.

**GENITALIA** ♂ (Fig. 35). Subscaphium slender, T-shaped at basal extremity. Valva very elongate, slightly concave at middle of ventral margin. Vinculum a little longer than two-thirds length of valva. Aedeagus slender, pointed at apex, almost as long as valva, without cornutus. 7th and 8th abdominal segments sparsely scaled, each with one pair of coremata; coremata with elongate hairs, anterior pair 1.5 times length of posterior pair; medial apodeme of 7th sternite short.

**GENITALIA** ♀ (Fig. 59). Apophyses anteriores similar to apophyses posteriores, rather long. Lamella postvaginalis not distinct; lamella antevaginalis absent. Antrum very short, weakly sclerotized; ductus bursae elongate, entirely membranous; corpus bursae large, pyriform, with pair of corniform, almost straight signa that are symmetrically positioned but differing in size, the smaller five-sixths the length of the larger.

**DISTRIBUTION.** W. Malaysia, Java.

**BIOLOGY.** Larva mining leaves of *Cajanus cajan* Linn. (Leguminosae) (Meyrick, 1934).



MATERIAL EXAMINED. 2♀, W. MALAYSIA: W. Pahang, Genting Tea Estate, 2000', 1-29.xi.1981 (*Tuck*) (genitalia slide no. 26800; BMNH).

DIAGNOSIS. This species is allied to *C. theivora*, but is distinctly broader-winged; it may be recognised by the characteristic straight dark line and pale wedge in the costal area of the fore wing cilia.

*Caloptilia etiolata* sp. n.

(Figs 5, 36, 60)

ADULT (Fig. 5) ♂♀, 10.0 mm. Face shining yellowish white; head ochre-yellow, almost entirely ochreous anteriorly. Palpi white; labial palpus with scattered ochreous scales beneath and with more or less ochre-brown apex; maxillary palpus ochre-brown at extreme apices of the two distal segments. Fore and mid leg ochre-brown, tarsi shining white; hind leg white, distal half of femur more or less ochre-brown, an ill-defined ochreous ring on each tarsal segment. Fore wing light ochre-brown with purple reflection, with a few groups of black scales scattered along termen; dorsum posterior to fold entirely yellowish white; two ill-defined semi-circular yellowish white blotches on costa, the first extending from one-quarter to one-half and coalescent with pale dorsum, with several black scales on its costal and posterior margin, second more blurred and extending from just beyond one-half to curve of costa close to apex, extending posteriorly to one-half width of wing; cilia around apex ochre-brown with two greyish lines.

GENITALIA ♂ (Fig. 36). Subscaphium slender. Valva elongate, slightly upturned from apical third, ventroapical corner somewhat rounded, with dense, long fine setae. Vinculum two-thirds length of valva. Aedeagus as long as valva, tapered towards apex, without cornutus. 7th and 8th abdominal segments sparsely scaled, each with pair of coremata; coremata with elongate hairs, posterior pair nearly four-fifths length of anterior pair; medial apodeme of seventh sternite of moderate length.

GENITALIA ♀ (Fig. 60). Apophyses anteriores short, similar to apophyses posteriores. Lamella postvaginalis large, trapezoidal; lamella antevaginalis absent. Antrum very short; ductus bursae very slender, elongate, entirely membranous; corpus bursae large, elongately ovate; with a pair of slender, hook-shaped signa, one of which is slightly shorter and positioned further caudad than the other.

DISTRIBUTION. W. Malaysia.

BIOLOGY. Unknown.

MATERIAL EXAMINED. Holotype ♂, W. MALAYSIA: W. Pahang, Genting Tea Estate, 2000', 22-31.x.1981 (*Tuck*) (genitalia slide no. 26815; BMNH). Paratypes, 1♀, data as holotype; 1♀, data as holotype but 1-8.xi.1981 (genitalia slide 27093; BMNH).

DIAGNOSIS. Compared with other *Caloptilia* species *etiolata* is very pale-coloured and the yellow marks on the fore wing are very blurred. The genitalia resemble those of *sphenocrossa* but may be easily distinguished by the straighter ventral margin of the valva in the male and by the more pronounced asymmetry in size and position of the signa in the female.

*Caloptilia flavida* Liu & Yuan, 1990

(Figs 6, 37, 61)

*Caloptilia* (*Caloptilia*) *flavida* Liu & Yuan, 1990: 90, fig. 23. Holotype ♂, CHINA: Sichuan, Qingchengsan, 27.v.1979 (*Liu*) (IZAS) [examined].

ADULT (Fig. 6) ♂♀, 9.0-11.5 mm. Face white with yellow sheen; head pale yellowish brown. Palpi white with more or less yellow sheen; labial palpus with a few black ventral scales scattered on second segment, apical third of terminal segment black except at extreme tip; maxillary palpus with a black medial dot. Fore and mid leg dark brown with slight purple gloss, tarsi silvery white with brown apical ring on each segment; hind leg with coxa and femur brassy yellow, femur purplish brown on distal half, tibia and tarsus pale ochre-yellow, tibia and first tarsal segment more or less infuscated above. Fore wing ochre-yellow with purplish brown strigulae especially dense at base of costa and in tornal field; a broad brassy yellow blotch from basal one-fifth of costa to near apex, somewhat narrowing towards fold and reaching one-half width of wing, 6-9 black dots along costa; cilia around apex dark grey with three blackish lines.

GENITALIA ♂ (Fig. 37). Subscaphium moderate, broadened into a fan-shape at basal extremity. Valva elongate, dilated apically, terminal margin rounded. Vinculum about two-thirds length of valva. Aedeagus as long as valva, without cornutus. 7th and 8th abdominal segments covered with short, rounded scales, each with one pair of coremata; coremata with elongate hairs, anterior pair about twice length of



posterior pair; medial apodeme of 7th sternite absent.

**GENITALIA ♀** (Fig. 61). Apophyses anteriores similar to apophyses posteriores. Lamella postvaginalis semicircular; lamella antevaginalis absent. Antrum about one-sixth length of ductus bursae; ductus bursae short, only two-thirds length of corpus bursae, strongly sclerotized except for anterior one-fifth; corpus bursae large, ovoid; with a pair of signa that are equal in size and slightly asymmetrical in position.

**DISTRIBUTION.** China (south) (Liu & Yuan, 1990), Thailand.

**BIOLOGY.** Larva mining leaves of *Ziziphus jujuba* var. *spinosa* (Bunge) Hu (Rhamnaceae) (Liu & Yuan, 1990).

**MATERIAL EXAMINED.** 1♀, C. THAILAND: Khao Yai NP, ca. 800m, 22–25.ii.1988 (Bradley *et al.*) (genitalia slide no. 27137; BMNH); 1♂, data similar but Khao Khieo ('Mt Khiew'), ca. 1200m, 12.vii.1989 (BMNH); 5♂, 4♀, data similar but 750m, 26.ii.–2.iii.1990 (genitalia slide no. 27136; BMNH).

**DIAGNOSIS.** *C. flavida* is closely related to *C. acericola* Kumata, 1966, a species distributed in Japan and the far eastern U.S.S.R., but it may be distinguished easily by genital differences: in males both the costo- and ventro-apical corners of the valva are more sharply angled; in females the antrum is not dilated, and a much greater length of the ductus bursae is sclerotized.

***Caloptilia ariana* (Meyrick, 1914), comb. n.**

(Figs 7, 28, 38, 62)

*Gracilaria ariana* Meyrick, 1914: 122. Holotype ♀, SRI LANKA ('Ceylon'): Pundaloya, ix (Green) (BMNH) [examined].

*Caloptilia heliciae* Kumata, 1966: 16, figs 3(19), 10(40), 20(63). Holotype ♂, JAPAN: Kyushu, Anbo, 30.xi.1959 (*Kuroko*) (Ent. Lab., Kyushu University) [not examined]. **Syn. n..**

*Caloptilia (Caloptilia) heliciae*; Kumata, 1982: 40–41, figs.

**ADULT** (Fig. 7) ♂♀, 10.0–13.0 mm. Face silvery white or shining white; head greyish yellow with purple gloss. Palpi white, more or less suffused with crimson; labial palpus with blackish subapical ring (but in Sulawesi specimen apex of second segment and entire third segment excepting apex with dense black scales); maxillary palpus with dense black ventral scaling at apex of each segment (but black scaling more extensive

in Sulawesi specimen). Fore and mid leg black, evenly speckled with crimson, but coxa shining white except at apex, tarsi white with black apical ring on each segment; hind leg with coxa and femur brassy yellow, tibia and tarsus yellow. Fore wing brassy yellow; costal margin tinged ferruginous towards base; with a blackish basal spot at about one-seventh; a narrow crimson-copper streak along dorsum from base to apex and thence to costa, about one-quarter to one-third breadth of wing, marked along dorsum with a series of deep indigo-blue strigulae; cilia around apex pale crimson, without lines.

**GENITALIA ♂** (Figs 28, 38). Subscaphium slender, not widened at basal extremity. Valva elongate, slightly dilated towards apex, ventroapical corner rounded. Vinculum slightly less than half length of valva. Aedeagus needle-like, about 1.2 length of vinculum, without cornutus. 7th and 8th abdominal segments devoid of scales, each with one pair of coremata; posterior coremata spade-shaped, composed of broad scales, only about one-third length of anterior coremata; medial apodeme of 7th sternite slender, two-thirds length of dorsal ridge of 8th segment.

**GENITALIA ♀** (Fig. 62). Apophyses anteriores similar to apophyses posteriores. Lamella postvaginalis strongly sclerotized, rather narrow, obtuse-triangular; lamella antevaginalis absent. Antrum very short; ductus bursae slender, dilated anteriorly, entirely membranous; corpus bursae ovoid; with a pair of corniform, slightly curved signa that are asymmetrical in position.

**DISTRIBUTION.** Sri Lanka, India, Japan, Thailand, Sabah, Sulawesi.

**BIOLOGY.** Larvae mining leaves of *Helicia cochinchinensis* Lour. (Proteaceae) (Kumata, 1966).

**MATERIAL EXAMINED.** 1♂, 1♀, INDIA: Khasi Hills, vii.1894 (*Doncaster*) (genitalia slide nos 27106, 27285; BMNH); 1♀, C. THAILAND: Khao Yai NP, ca. 800m, 22–25.ii.1988 (Bradley *et al.*) (genitalia slide no. 27134; BMNH); 1♂, SABAH: Mt Kinabalu, nr Kundasang golf course, 1500m, 17–20.v.1989 (*Tuck*) (genitalia slide no. 27095; BMNH); 1♂, INDONESIA: Sulawesi Utara, Gunung Muajat, 1780m, 7–8.xi.1985 (*Project Wallace*) (genitalia slide no. 27255; BMNH).

**DIAGNOSIS.** *C. ariana*, *C. emas* and *C. baringi* (below), comprise a species-group related to *Caloptilia isochrysa* (Meyrick, 1908); the latter is known from Nepal, India and Japan. The three

species may be separated from *isochrysa* by their white fore coxae (in *isochrysa* the fore coxa is dark reddish brown). *C. ariana* may be distinguished from *emas* and *baringi* by its spade-shaped posterior coremata, absent in *baringi*, that are composed of broad scales instead of elongate hairs as in *emas*.

REMARKS. In Kumata's original (1966) description of *C. heliciae* he wrote 'In colour this species is closely related to *C. ariana* (Meyrick, 1914) of Ceylon, but may be distinguished from the latter by the white fore coxa, by the fore wing with crimson-coppery hind area being about  $\frac{1}{4}$  as wide as wing, and by the smaller size (the alar expanse is 10.0 mm in present species, while 13.0 mm in *ariana*)'. We have examined the holotype of *ariana* which unfortunately is very badly damaged, with the abdomen and right fore wing missing. However, it is in all respects similar to *heliciae*, including having a white fore coxa. Specimens from South-East Asia which, by comparison of the genitalia, we consider conspecific with *heliciae* exhibit considerable variation in size and in the width of the crimson-copper hind area of the fore wing. The holotype of *ariana* falls within the range of this variation and we conclude that it is conspecific with *heliciae*.

Apart from the more extensive black scaling on the labial and maxillary palpi, the single specimen from Sulawesi (above) is in all respects similar to other specimens of this species that we have examined.

### *Caloptilia emas* sp. n.

(Figs 8, 39)

ADULT (Fig. 8) ♂, 12.0–14.0 mm. Face golden yellow; head pale crimson with slight purple gloss. Palpi brassy yellow, ventrally more or less tinged with crimson; labial palpus with subapical blackish ring. Fore and mid leg black, outer surface densely speckled with crimson, fore coxa silvery white except at apex, tarsi white with a faint black ring on each segment; hind leg with coxa and femur golden yellow, tibia and tarsus white. Fore wing golden yellow with a single black spot in middle of costa; basal corner of costa crimson, without any blackish spot; a narrow crimson streak with a purple gloss extending along dorsum from base to apex and extending to costa, about one-quarter breadth of wing, with three separate obtuse-triangular inward extensions at one-quarter, one-half and three-fifths; streak punctuated along dorsum with a series of deep indigo-blue strigulae; cilia around apex pale crimson, without dark or pale lines.

GENITALIA ♂ (Fig. 39). Subscaphium slender, not broadened at basal extremity. Valva gradually dilated towards apex, ventro-apical corner rounded, with a series of short spiny setae along the apical two-thirds of the ventral margin in addition to the normal hair-like setae. Vinculum less than one-half length of valva. Aedeagus 1.2 length of vinculum, slightly swollen in apical two-thirds, without cornutus. 7th and 8th abdominal segments with sparse scaling only on 8th, each with one pair of coremata; coremata with elongate hairs, anterior pair about three times length of posterior pair; medial apodeme of 7th sternite a little longer and thicker than dorsal ridge of 8th segment.

GENITALIA ♀. Unknown.

DISTRIBUTION. W. Malaysia.

BIOLOGY. Unknown.

MATERIAL EXAMINED. Holotype ♂, W. MALAYSIA: Cameron Highlands, Gunung Brinchang, 1980m, 15–23.viii.1986 (*Robinson*) (genitalia slide no. 26804; BMNH). Paratype ♂, similar data but 23–31.x.1989 (*Robinson & Tobin*) (BMNH).

DIAGNOSIS. This species is very closely related to *C. ariana*, but may be easily distinguished by the comparatively uneven crimson streak on the dorsum of the fore wing; the streak has an almost straight anterior margin in *ariana*. In the male genitalia the posterior coremata consist of elongate hairs rather than broad scales as in *ariana*.

### *Caloptilia baringi* sp. n.

(Figs 9, 40, 63)

*Caloptilia* sp.; Robinson, 1984: pl. 2, fig. 8 (colour).

ADULT (Fig. 9) ♂♀, 12.0–13.0 mm. Face golden yellow; head dark ochre-brown with slight purple gloss. Palpi brassy yellow; labial palpus slightly tinged with crimson ventrally, apical third black except at extreme tip; maxillary palpus covered ventrally with black scales. Fore and mid leg black, outer surface speckled with crimson, coxa silvery white except at apex; tarsi white with a black apical ring on each segment; hind leg with coxa and femur golden yellow, tibia and tarsus white, tibia and first tarsal segment slightly infuscated above, with a small brown apical ring on each tarsal segment. Fore wing golden yellow, costal margin tinged with ferruginous towards base, and with several



black spots; a narrow crimson-copper streak along dorsum from base to apex and extending to costa, about one-quarter breadth of wing, marked along dorsum with a series of deep indigo-blue strigulae; cilia around apex pale crimson-copper with two narrow black bands.

**GENITALIA** ♂ (Fig. 40). Subscaphium absent. Valva knife-shaped, only slightly dilated towards apex, the ventro-apical corner quite broadly rounded, with a slight emargination near middle of ventral margin. Vinculum slightly longer than one-half length of valva, apex blunt and bent slightly dorsad. Aedeagus about three-quarters length of valva, slightly swollen medially, without cornutus. 7th and 8th abdominal segments devoid of scales, with only a single pair of coremata, on 7th segment; coremata with elongate hairs; medial apodeme of 7th sternite moderate, about three-quarters length of dorsal ridge of 8th segment.

**GENITALIA** ♀ (Fig. 63). Apophyses anteriores very slender, similar to apophyses posteriores. Lamella postvaginalis weakly sclerotized, obtuse-triangular, with a small medial notch in anterior margin; lamella antevaginalis absent. Antrum cup-shaped, weakly sclerotized, about half length of apophyses; ductus bursae very slender and elongate, entirely membranous; corpus bursae ovoid; with a pair of signa that are equal in size and slightly asymmetrical in position.

**DISTRIBUTION.** India (Sikkim), Brunei, Sabah, Sulawesi.

**BIOLOGY.** Unknown.

**MATERIAL EXAMINED.** Holotype ♂, BRUNEI: Bukit Retak, 1365m, LP 238, GR 873804, moss forest, 1-4.v.1989 (*Allen & Tuck*) (genitalia slide no. 26805; BMNH). Paratypes, 6♂, BRUNEI: Bukit Pagon, 5520', LP 308, upper montane forest, 15-20.ii.1982 (*Robinson*) (genitalia slide no. 27286; BMNH); 1♀, SABAH: Mt Kinabalu, nr Kundasang golf course, 1500m, 17-20.vi.1989 (*Tuck*) (genitalia slide no. 27165; BMNH). Excluded from paratype series, 1♂, INDONESIA: Sulawesi Utara, Dumoga-Bone NP, Clarke Camp, 1140m, lower montane forest, iii.1985 (*Project Wallace*) (BMNH); 1♂, INDIA: Sikkim, 7000', vii.1895 (*Pilcher*) (genitalia slide no. 27105; BMNH).

**DIAGNOSIS.** *C. baringi* is closely related to *ariana* and *emas* (above) but exhibits distinct genital differences in the male: absence of coremata from the 8th abdominal segment, a very

unusual feature in *Caloptilia*; a longer vinculum than in either of the other species; absence of the subscaphium present in the others. It may be distinguished from *ariana* by the more numerous indigo-blue strigulae in the dorsal streak on the fore wing.

**REMARKS.** We have excluded specimens from Sikkim and Sulawesi from the paratype series. The male from Sikkim exhibits slight differences in the male genitalia from Bornean specimens, the ventral margin of the valva lacking the slight emargination. The specimen from Sulawesi is slightly darker than specimens from Brunei and Sabah. In other respects the Sikkim and Sulawesi specimens are similar to those from Borneo.

***Caloptilia iorphna* (Meyrick, 1939),  
comb. n.**

(Figs 10, 41, 64)

*Gracilaria iorphna* Meyrick, 1939: 60. LECTO-TYPE ♂, JAVA: Telawa, 29.vii.1935 (*Kalshoven*) (genitalia slide; RNH, Leiden), here designated [examined].

**ADULT** (Fig. 10) ♂♀, 7.5-9.0 mm. Face white, with slight ochre tint; head ochre-brown with purple gloss. Palpi yellowish white; labial palpus with second segment sparsely speckled with black scales ventrally, third segment suffused with black on apical two-fifths, both segments each with a black apical ring. Fore and mid leg dark brown, tarsi shining white; hind leg with coxa and femur yellowish white, femur black on distal half; tibia and tarsus pale ochreous grey. Fore wing dark grey with violet gloss, costal edge from one-quarter to three-quarters slightly paler with about eight black dots; cilia around apex dark grey with three black lines.

**GENITALIA** ♂ (Fig. 41). Subscaphium moderate, slightly dilated at basal extremity. Valva slender, curved dorsad in distal third; apical margin rounded, densely covered with the usual elongate setae. Vinculum about four-fifths length of valva, tapering to pointed apex of saccus. Aedeagus about 1.6 length of vinculum, without cornutus. 7th and 8th abdominal segments partly covered by short scales, each with one pair of coremata; coremata with elongate hairs, anterior pair about three times length of posterior pair; medial apodeme of 7th sternite absent.

**GENITALIA** ♀ (Fig. 64). Apophyses anteriores thicker and shorter than apophyses posteriores. Lamella postvaginalis trapezoidal; lamella antevaginalis narrow, very weakly sclerotized.



Antrum very short; ductus bursae weakly sclerotized for entire length, sclerotization distinctly stronger in posterior half than anterior half, about as long as corpus bursae; corpus bursae pyriform; with a pair of sickle-shaped signa that are equal in size and symmetrical in position.

DISTRIBUTION. Java.

BIOLOGY. Larvae mining leaves of *Mucuna* (Leguminosae) (Meyrick, 1938).

MATERIAL EXAMINED. 1♂ (paralectotype of *iorphna*, abdomen missing), data as lectotype (BMNH); 1♀ (determined as *iorphna* by Meyrick), data as lectotype (genitalia slide; RNH, Leiden).

DIAGNOSIS. *C. iorphna* and *C. tangkai* (below) resemble *C. soyella* in colour but can be easily distinguished by the absence of the strongly developed ridge on the valva of the male. *C. iorphna* may be distinguished from *tangkai* by its lack of dilation of the apex of the valva and by the absence of the apodeme of the 7th sternite. (See also the diagnoses for *soyella* and *tangkai*.)

### *Caloptilia tangkai* sp. n.

(Figs 11, 42)

ADULT (Fig. 11) ♂, 9.0 mm. Face yellowish white; head ochre-brown, but frons shining white. Palpi white; labial palpus ventrally suffused more or less with ochre, and dotted with several blackish scales, apical half of third segment black except at extreme tip. Fore and mid leg dark brown, tarsi white with a black apical ring on each segment; hind leg with coxa and femur yellowish white, a brown patch on distal half of femur; tibia and tarsus pale ochre-brown, with a brown apical ring on each tarsal segment. Fore wing ochre-brown with purple reflection, evenly covered with ill-defined dark brown strigulae on an almost uniform ground colour; 10–12 dark brown dots evenly distributed on costa; cilia around apex ochre-brown in proximal half, grey with three black lines in distal half; cilia along costal margin just before apex of wing paler, ochre-yellow except at tips of scales.

GENITALIA ♂ (Fig. 42). Subscaphium slender, slightly broadened at basal extremity. Valva somewhat elongate, strongly dilated beyond middle, costa rather curved, ventro-apical margin rounded and with fine setae. Vinculum nearly two-thirds length of valva, tapering to pointed apex of saccus. Aedeagus about three-quarters length of valva, without cornutus. 7th and 8th

abdominal segments thickly scaled, each with a pair of coremata; coremata with elongate hairs, anterior pair very long, about four times length of posterior pair; 7th sternite strongly reduced with a vestigial medial apodeme.

GENITALIA ♂. Unknown.

DISTRIBUTION. Thailand.

BIOLOGY. Unknown.

MATERIAL EXAMINED. Holotype ♂, N. THAILAND: Chiang Mai, 750m, 11.xii.1985 (Allen) (genitalia slide no. 27166; BMNH). Paratypes, 1♂, data as holotype; 3♂, N.E. THAILAND: Chulabhorn ('Chulaphon') Dam, 730m, 12–13.ii.1990 (Bradley *et al.*) (genitalia slide no. 27133; BMNH).

DIAGNOSIS. This species is closely related to *iorphna* (above) but may be distinguished by differences in the male genitalia: distinct dilation of the apical half of the valva, and the presence of a short medial apodeme on the 7th sternite. (See also the diagnosis of *iorphna*.)

REMARKS. The three male specimens collected by Bradley *et al.* from N.E. Thailand in February are a little darker than the specimens collected by Allen from further west in December. Similar colour variation in Sphingidae from northern Thailand has been noted by Kitching (pers. comm.) and is thought to represent seasonal variation.

### *Caloptilia hemiconis* (Meyrick, 1894)

(Figs 12, 43, 65)

*Antiolopha hemiconis* Meyrick, 1894: 25. LECTOTYPE ♂, BURMA: Koni, ix.1888 (Manders) (BMNH), here designated [examined].

*Gracilaria raptocrossa* Meyrick, 1932: 271. Holotype ♂, JAVA: Seneng, ix.1931 (Kalshoven) (BMNH) [examined]. **Syn. n.** *Gracilaria hemiconis*; Meyrick, 1908: 831. *Caloptilia hemiconis*; Vári, 1961: 3.

ADULT (Fig. 12) ♂♀, 8.0–9.0 mm. Face white with slightly ochreous tint; head similar. Palpi white; labial palpus with apex of second and tuft of terminal segment black. Fore and mid leg whitish ochre, femur (excepting base) and tibia suffused with black; tarsi white suffused with ochre, black ring at apex of each segment (only on terminal segment in specimens from Java and Bali); hind leg with coxa and femur yellowish white, distal half of femur slightly brown; tibia and tarsus white suffused with ochre above, tarsi

each with a black ring. Fore wing light ochre-brown; proximal half of dorsal margin suffused with ochreous white; a pale triangular blotch from one-quarter to middle of costa, more or less suffused with white, and faintly outlined with black scales; apical one-seventh of wing also pale, marked proximally with an ill-defined black fascia and, further proximad, a few scales forming a black strigula; cilia around apex ochre-brown in proximal half, grey with three black lines in distal half.

**GENITALIA** ♂ (Fig. 43). Subscaphium moderate, T-shaped at basal extremity. Valva elongate, truncated distally, with small dentate projection close to ventral margin near base. Vinculum rather elongate, about as long as valva. Aedeagus very slender, abruptly swollen at base, about 1.4 length of vinculum, without cornutus. 7th and 8th abdominal segments sparsely scaled, each with pair of coremata; coremata with elongate hairs; 8th sternite only weakly sclerotized, 8th tergite only slightly reduced, trapezoidal; medial apodeme of 7th sternite vestigial.

**GENITALIA** ♀ (Fig. 65). Apophyses anteriores similar to apophyses posteriores, elongated and thickened. Ostium bursae teardrop-shaped, located in centre of 8th sternite. Antrum not developed; ductus bursae slender, membranous, as long as corpus bursae, with small colliculum at one-quarter length of ductus from ostium; corpus bursae elongate ovoid; with a pair of slender, hook-shaped signa that are similar in size and shape but asymmetrical in position.

**DISTRIBUTION.** India (Meyrick, 1908), Burma, Thailand, Java, Bali.

**BIOLOGY.** Unknown.

**MATERIAL EXAMINED.** 1♀, INDIA: Assam, Khasi Hills, ix.1906 (genitalia slide no. 26768; BMNH); 1♂, similar data (determined as *Gracilaria raptocrossa* by Meyrick) (BMNH); 1♂, N.E. THAILAND: Chulabhorn ('Chulaphon') Dam, 730m, 12–13.ii.1990 (*Bradley et al.*) (BMNH); 1♂, BALI: 1896 (*Doherty*) (genitalia slide no. 27111; BMNH).

**DIAGNOSIS.** *C. hemiconis* is very closely related to *dogmatica*, but may be easily distinguished by the absence of the bright yellow triangular spot on the forewing, the longer vinculum in the male genitalia, and the shorter ductus bursae in the female genitalia. A unique feature of this species is the development of a colliculum some distance away from the ostium bursae, and the corresponding loss of any sclerotization that

could be described as an antrum (and for which this term is used in the case of other species described here).

**REMARKS.** Direct comparison of the type specimens of *C. hemiconis* and *raptocrossa* suggests that they are conspecific.

### *Caloptilia soyella* (Deventer, 1904)

(Figs 13, 29, 44, 66)

*Gracilaria soyella* Deventer, 1904: 22, fig. 2(1).

LECTOTYPE ♂, JAVA: Pekalongan, xi. (Deventer) (RNH, Leiden), here designated [examined].

*Gracilaria soyella*; Fletcher, 1921: 166 (*partim*).  
*Caloptilia (Caloptilia) soyella*; Kumata, 1982: 87, figs.

**ADULT** (Fig. 13) ♂♀, 9.0–10.0 mm. Face yellow, tinted ochreous; head ochre-brown with purple gloss. Palpi ochre-white; labial palpus with second segment slightly infuscated ventrally, third segment black on apical half. Fore and mid leg dark brown with a purple gloss, tarsi snow-white with a black apical ring on each segment; hind leg with coxa and femur pale ochre-yellow, femur with a brown blotch near apex, tibia and tarsus pale ochre-grey, apex of tibia sometimes slightly infuscated above. Fore wing pale ochre-brown with purple gloss, rather uniformly coloured in specimens from India, Java and Fiji, with only a few black spots along costal margin; specimens from Japan and China with more dark markings, sprinkling of dark brown scales on discal area, and black strigulae along dorsal margin in addition to more numerous black spots along costal margin; cilia around apex of wing dark grey with three black lines.

**GENITALIA** ♂ (Figs 29, 44). Subscaphium slender; tegumen heavily sclerotized ventrally near base. Valva elongate, gradually dilated from one-quarter towards apex, terminal margin straight; a strongly developed ridge running from base of costa to ventro-apical corner, with two rows of stout setae on ridge. Vinculum nearly half as long as valva, apex blunt. Aedeagus about three-quarters length of valva, needle-shaped, without cornutus. 7th and 8th abdominal segments sparsely scaled, each with one pair of coremata; coremata with elongate hairs, anterior pair 2.5 times length posterior pair, medial apodeme of 7th sternite absent.

**GENITALIA** ♀ (Fig. 66). Apophyses anteriores similar to apophyses posteriores. Lamella postvaginalis and antevaginalis not differenti-



ated; ostium situated in centre of 8th sternite; 7th segment strongly sclerotized. Antrum short, broadly m-shaped; ductus bursae slender, entirely membranous; corpus bursae pyriform; with a pair of sickle-shaped signa that are equal in size and symmetrical in position.

**DISTRIBUTION.** India (Fletcher, 1921), China (north) (Liu & Yuan, 1990), Java, Japan (Kumata, 1982), Fiji.

**BIOLOGY.** Larvae mining leaves of various species of bean (Leguminosae): *Soya hispida* Moench (Deventer, 1904); *Cajanus cajan* Linn. (as *C. indicus* Sprengel), *Phaeolus mungo* Linn. (Fletcher, 1921); *Phaseolus calcaratus* Roxb.; *Azuki* *angularis* Ohwi, *Glycine max* Linn., *Kummerovia striata* Schindler and *Lespedeza cytototrya* Miq. (Kumata, 1982).

**MATERIAL EXAMINED.** 1 ex. (paralectotype of *soyella*; abdomen missing), data as lectotype (RNH, Leiden); 1♀, INDIA: Pusa, 21.vi.1916, cage no. 1409 (Fletcher) (genitalia slide no. 27271; BMNH); 1♂, CHINA: Peijing, Huairou, 29.viii.1984 (Yuan) (genitalia slide no. 27288; BMNH); 1 ex. (abdomen missing), FIJI: Lautoka, 16.v.1921, ex *Phaseolus calcaratus* Roxb. (Greenwood) (BMNH).

**DIAGNOSIS.** *C. soyella* is very closely related to *C. acrotherma* (Meyrick, 1908), from Sri Lanka, India and southern China, and to *C. prosticta* (Meyrick, 1909) with a range from southern Africa to India. All three species are pests of bean plants as larvae, and the adults are superficially similar. They may be distinguished by characters of the male genitalia. In *soyella* the valva is traversed by a strong ridge from the base of the costa to the ventroapical corner (fig. 44); *prosticta* has a ridge also, but it is weakly defined and runs only to a process on the ventral margin of the valva, not the apical corner; both *acrotherma* and *prosticta* have processes on the ventral margin of the valva whereas *soyella* does not; in *acrotherma* the process is thorn-shaped and arises from the middle of the ventral margin, in *prosticta* the process is broadly dentate and arises from beyond the mid-point of the ventral margin; in *acrotherma* the valva is of comparatively even breadth whereas in *prosticta* the valva is conspicuously dilated in the distal third.

**REMARKS.** All the specimens that were included in Meyrick's collection under the name 'soyella' are either *acrotherma* or *prosticta* with the exception of the single specimen from India listed above.

## *Caloptilia aurifasciata* Kumata, 1982

(Figs 14, 45, 67)

*Caloptilia (Caloptilia) aurifasciata* Kumata, 1982: 55, figs. Holotype ♂, JAPAN: Kozagawa, Wakayama-ken, em. 15–19.x.1974, ex *Rhus sylvestris* (Kumata) (genitalia slide no. Grc. 1806; EIHU) [not examined].

**ADULT** (Fig. 14) ♂♀, 9.0–11.0 mm. Face ochre-grey; head brown with purple reflection. Palpi white; labial palpus suffused ventrally with black, suffusion especially dense on second segment and on apical two-thirds of third segment. Fore and mid leg black with a few white strigulae on femora and tibiae; tarsi white, each segment with a black apical ring which may be as broad as one-half length of segment; hind leg with coxa and femur brassy yellow, apex of each dotted with black or brown scales; tibia and tarsus ochre-yellow, more or less infuscated except at base of each segment. Fore wing dark brown with purple reflection, with two fasciae, three pairs of opposed costal and dorsal blotches, and one apical spot, all these markings brassy yellow and edged with black scales; first fascia basal, strongly oblique distally towards dorsum, much dilated and sometimes interrupted by black scales on dorsum; first pair of blotches near middle of wing, coalesced at fold, costal blotch triangular and much larger than other blotches, with a few black dots on costal margin; second pair of blotches at middle of wing, costal blotch further distad than dorsal blotch, both small and triangular, their height not exceeding one-quarter breadth of wing; third pair at about three-quarters of wing, composed of small strigulae, costal blotch closer to wing apex than dorsal blotch and extending to one-half breadth of wing, dorsal blotch about one-quarter breadth of wing; second fascia just before wing apex, slightly interrupted in middle, only one-third width of basal fascia; spot at wing apex; cilia around apex dark brown with two or three pale lines.

**GENITALIA** ♂ (Fig. 45). Subscaphium moderate, broadly Y-shaped at basal extremity. Valva knife-shaped, costa curved near basal one-third, ventral margin slightly concave in middle, ventro-apical corner rounded, with typical elongate setae. Vinculum about one-half length of valva. Aedeagus 1.3 length of valva, slightly curved apically, with numerous microtrichia on apical half of vesica; without cornutus. 7th and 8th abdominal segments densely covered with elongate scales, each with one pair of coremata;



coremata with elongate hairs, anterior pair about twice length of posterior pair; medial apodeme of 7th sternite slender, about one-third length of medial ridge of 8th tergite.

**GENITALIA ♀** (Fig. 67). Apophyses anteriores shorter and thicker than apophyses posteriores. Lamella postvaginalis large, elongately trapezoidal; lamella antevaginalis absent. Antrum large, bell-shaped, about one-third length of ductus bursae, strongly sclerotized; ductus bursae thick-walled, posterior half membranous and lined with microtrichia, anterior half gradually widened towards corpus bursae, heavily sclerotized; corpus bursae pyriform; with a pair of sickle-shaped signa that are of equal size and are nearly symmetrical in position.

**DISTRIBUTION.** Japan, Hong Kong, Thailand, W. Malaysia.

**BIOLOGY.** Larva mining leaves of *Rhus succedanea* Linn. and *R. sylvestris* Sieb. et Zucc. (Anacardiaceae) (Kumata, 1982).

**MATERIAL EXAMINED.** 1♀, HONG KONG: Sek Kong Water Course, 3.viii.1981 (*Oxford Far East Exp.*) (genitalia slide no. 26999; BMNH); 1♂, N. THAILAND: Chiang Mai, Doi Suthep-Pui NP, ca. 1500m, 9–10.iii.1988 (*Bradley et al.*); 1♂, C. THAILAND: Khao Yai NP, ca. 800m, 22–25.ii.1988 (*Bradley*); 1♀, same data but 750m, 26.ii.–2.iii.1990 (*Bradley et al.*) (BMNH); 2♂, W. MALAYSIA: Fraser's Hill, Jeriau Road and Gap Road, 1140–1190m, 5–12.viii.1986 (*Robinson*) (genitalia slide no. 27257; BMNH).

**DIAGNOSIS.** *C. aurifasciata* may be easily distinguished from all other *Caloptilia* species by its peculiar wing pattern.

***Caloptilia scaeodesma*** (Meyrick, 1928),  
**comb. n.**

(Figs 15, 46, 68)

*Gracilaria scaeodesma* Meyrick, 1928: 409. Holotype ♂, VANUATU ('New Hebrides'): Makekula I., 29.viii.1925 (*Buxton*) (BMNH) [examined].

**ADULT** (Fig. 15) ♂♀, 10.0–11.0 mm. Face fuscous; head greyish. Palpi dark grey; labial palpus with white rings at base, middle and apex of third segment; maxillary palpus with basal half of each segment white. Fore and mid leg dark brown except for basal half of fore coxa which is yellowish white, tarsi white with ochre-brown apical ring on each segment; hind leg with coxa

and femur dark brown, femur with three narrow white rings at base, middle and apex, tibia and tarsus pale brown, base of each segment white. Fore wing dark grey with faint violet tint; three brassy yellow fasciae edged with blackish scales, first at one-fifth, oblique, slightly broadened on dorsum, second at one-half, third at three-quarters, its dorsal half infilled with black scales; a small white spot at seven-eighths of costa; an indistinct transverse streak of black suffusion just before apex; apex grey; cilia around apex of wing grey, base of cilia with two diffuse white spots at termen and a single white spot on costa.

**GENITALIA ♂** (Fig. 46). Subscaphium moderate, narrowing towards basal extremity, with a tuft of setae to either side on diaphragma. Valva rather broad, costa nearly straight, ventral margin rounded and covered with elongate hair-like setae throughout its length. Vinculum about half length of valva. Aedeagus about 1.5 times length of vinculum, ductus ejaculatorius elongate, nearly four times length of aedeagus, without cornutus. 7th abdominal segment devoid of scales, 8th densely covered with short scales, each segment with one pair of coremata; coremata with elongate hairs, anterior pair twice length of posterior pair; medial apodeme of 7th sternite absent.

**GENITALIA ♀** (Fig. 68). Apophyses anteriores slender, similar to apophyses posteriores. Lamella postvaginalis not differentiated, 8th sternite reduced to a narrow transverse line of sclerotization; lamella antevaginalis absent. Antrum short, weakly sclerotized; ductus bursae slender and long, entirely membranous; corpus bursae short, ovoid, with a small appendix bursae connected by a short ductus at anterior end, corpus bursae about three times as large as appendix bursae; with a pair of signa that are equal in size but strongly asymmetrical in position.

**DISTRIBUTION.** Sri Lanka, India (Andaman Is), W. Malaysia, Singapore (*Murphy, in litt.*), Indonesia (Anambas Is), Vanuatu.

**BIOLOGY.** Larva mining leaves of mangrove, *Rhizophora* (Rhizophoraceae) and *Sonneratia* spp. (Sonneratiaceae) (label data, below, and *Murphy, in litt.*).

**MATERIAL EXAMINED.** 1♀, SRI LANKA ('Ceylon'): Peradeniya, iii.1911 (*Walsingham*) (BMNH); 2♂, INDIA: Andaman Is, Port Blair, 28.ix.1991, ex *Sonneratia* (*Prashanth/Veena*); 2♂, W. MALAYSIA: Selangor, Sungai Langat, 30.i.1944, ex mangrove (*Takahashi*) (genitalia slide no. 27075; BMNH); 1♀, INDONESIA:

Kep. Anambas, N. coast of Djemadja, Telok Padang, iv.1928 (*M.R.H.*) (genitalia slide no. 27076; BMNH).

**DIAGNOSIS.** This species is distinguished within *Caloptilia* by its colour pattern and autapomorphic genital features, in the male the brushes of hair either side of the subscaphium, and in the female the distinctive appendix bursae.

**REMARKS.** Despite its unusual features, there is no evidence to suggest that *scaeodesma* is other than a true *Caloptilia*.

*Caloptilia syrphettias* (Meyrick, 1907),  
**comb. n.**

(Figs 16, 47, 69)

*Gracilaria syrphettias* Meyrick, 1907: 984. LECTOTYPE ♂, SRI LANKA ('Ceylon'): Maskeliya, vii.1905 (*Pole*), here designated [examined].

*Gracilaria zopherotarsa* Meyrick, 1936: 39. Lectotype ♂, CHINA: Sichuan, Guanxian ('Kwanhsien'), vii.1928 (*F[ranck]*) (genitalia slide no. 26754; BMNH), designated by Yuan, 1992 [examined]. **Syn. n.**

*Caloptilia (Caloptilia) perseella* Kumata, 1982: 93, figs 35, 56G, 56H. Holotype ♂, JAPAN: Sata, em. 13–30.iv.1958, ex *P. thunbergii* (*Issiki & Yasuda*) (genitalia slide no. Grc-648; EIHU, Sapporo) [not examined]. **Syn. n.**

**ADULT** (Fig. 16) ♂♀, 13.0–17.0 mm. Face slightly greyish white; head dark grey. Palpi fuscous, white (sometimes slightly ochreous white) on upper surface. Fore and mid leg dark brown, tarsi ochre-white with basal half of first segment black, each tarsomere with apical black ring; hind leg with coxa and femur yellowish white sparsely irrorated with fuscous, femur fuscous on apical two-thirds, tibia and tarsus dark grey, 2nd to 4th tarsomeres ochreous at extreme base. Fore wing very narrow, costa and dorsal margin almost parallel, dark brown with purple reflection, sparsely covered with ochre-yellow strigulae, on costal margin strigulae very short and alternated with black dots; cilia around apex of wing dark brown with a pale, vertical subapical line.

**GENITALIA** ♂ (Fig. 47). Subscaphium slender. Valva large, costal margin almost straight, ventro-apical corner rounded and covered by the usual elongate fine setae, a patch of setae on outer surface near base of valva. Vinculum narrowing strongly from one-half, about 0.8 length

of valva, with a pair of lateral cavities close to base, each with a tuft of elongate setae. Aedeagus as long as valva, with two thin and elongate cornuti each about half the length of the aedeagus. 7th abdominal segment devoid of scales, 8th with sparse covering of scales, each segment with one pair of coremata; posterior coremata with hairs of mixed length, anterior coremata with elongate hairs, posterior pair two-thirds to three-quarters length of anterior pair; medial apodeme of 7th sternite very short.

**GENITALIA** ♀ (Fig. 69). Apophyses anteriores slender, similar to apophyses posteriores. Lamella postvaginalis narrow, extended-trapezoidal, with small anterior emargination; lamella antevaginalis narrower but more strongly sclerotized. Antrum short, weakly sclerotized; ductus bursae very slender, entirely membranous; corpus bursae ovoid; with a pair of narrow, sickle-shaped signa, one of which is more strongly curved, narrower and more elongated than the other.

**DISTRIBUTION.** Sri Lanka, India, Japan, China (south), Thailand, W. Malaysia, Brunei, Sulawesi.

**BIOLOGY.** Larvae mining leaves of *Persea thunbergii* Kosterm. (Lauraceae) (Kumata, 1982).

**MATERIAL EXAMINED.** 1♂ (paralectotype of *syrphettias*), SRI LANKA ('Ceylon'): Maskeliya, x.1905 (*Pole*) (genitalia slide no. 27149; BMNH); 2 ex. (abdomens missing) (paralectotypes of *syrphettias*), similar data but vii.1905; 5 ex., SRI LANKA, various localities and dates; 1♂, INDIA: Assam, Shillong, 5000', ix.1917 (*Fletcher*); 1♀ (paralectotype of *zopherotarsa*), CHINA: Sichuan, Guanxian ('Kwanhsien'), vii.1928 (*F[ranck]*) (genitalia slide no. 26755; BMNH); 1♂, W. THAILAND: Uthai Thani Prov., Khao Nang Rum NP, 400m, 6–8.vi.1986 (*Allen*) (genitalia slide no. 26832; BMNH); 1♂, W. MALAYSIA: W. Pahang, Genting Highlands, ca. 4400', 17.xi.1981 (*Tuck*) (genitalia slide no. 26831; BMNH); 1 ex. (abdomen missing), BRUNEI: Bukit Retak, 1365m, LP 238, GR 873804, 1–4.v.1989 (*Allen & Tuck*) (BMNH); 1♀, INDONESIA: Sulawesi Utara, Dumoga-Bone NP, Clarke Camp, lower montane forest, 1140m, iii.1985 (*Project Wallace*) (BMNH).

**DIAGNOSIS.** This species may be distinguished easily from other *Caloptilia* species by the tufts of elongate setae at either side of the vinculum in



the male, and by the patch of setae on the outer surface of the valva.

REMARKS. The drab and nondescript appearance of this species, reflected in its original description, appears to have led both Meyrick and Kumata into redescribing it. The specimen from Brunei is much darker than the other specimens that we have examined; its lacking the abdomen means we are unable to confirm its identity.

*Caloptilia acinata* sp. n.

(Figs 17, 48, 70)

ADULT (Fig. 17) ♂♀, 11.5–15.0 mm. Face yellowish white; head ochre-brown. Palpi white; labial palpus with second segment sparsely speckled with ochre-brown, third segment with black spot at base and at one-third, apical half blackish except at extreme tip. Fore and mid leg dark ochre-brown, fore coxa paler, tarsi white with pale ochre ring at apex of each segment; hind leg with coxa and femur brassy yellow, femur with black blotch in middle, tibia and tarsus white with slight ochre tint, tibia and first tarsal segment somewhat infuscated above. Fore wing ochre-brown with purple reflection, two large brassy-yellow blotches from one-quarter to middle and from a little beyond middle to near apex of costa, extending about two-thirds breadth of wing; 10–12 small black dots on costal margin, a much larger black spot on costa between the yellow blotches; several black strigulae along termen close to apex; cilia around apex ochre-grey with three black lines.

GENITALIA ♂ (Fig. 48). Tegumen very weakly sclerotized. Subscaphium absent. Valva elongate, slightly broadened and curved from one-third towards apex; ventro-apical margin rounded, with the usual elongate marginal setae but also with a marginal series of short stout setae of unequal lengths from one-third of ventral margin, six stout and elongate setae along ventral margin from close to base to about one-half, with a particularly long and stout seta (two-fifths length of valva) from ventral margin near base. Vinculum broad, nearly four-fifths length of valva, apex almost truncated. Aedeagus slender, needle-like, slightly sinuate in apical half, without cornutus. 7th abdominal segment devoid of scales, 8th segment with sparse scaling, each segment with one pair of coremata; coremata with elongate hairs, anterior pair twice length of posterior pair; medial apodeme of 7th

sternite slender, only one-third length of medial ridge of 8th tergite.

GENITALIA ♀ (Fig. 70). Apophyses anteriores slender, similar to apophyses posteriores. Lamellae not differentiated; 8th abdominal segment sclerotized with longitudinal membranous cleft in middle of sternite, ostium close to anterior end of this cleft; 7th segment very strongly sclerotized, sternite very large. Antrum not developed; ductus bursae elongate, slender, entirely membranous; corpus bursae ovoid; with a pair of slender, hook-shaped signa that are asymmetrical in position.

DISTRIBUTION. India, Thailand.

BIOLOGY. Unknown.

MATERIAL EXAMINED. Holotype ♂, N. THAILAND: Doi Suthep-Pui NP, ca. 1500m, 9–10.iii.1988 (*Bradley et al.*) (BMNH). Paratypes, 2♂, INDIA: Khasi Hills, vii.1894 (*Doncaster*) (genitalia slide no. 27033; BMNH); 1♂, data as holotype; 1♀, C. THAILAND: Khao Yai NP, ca. 800m, 22–25.ii.1988 (*Bradley et al.*); 1♂, same data but 720m, 2–4.xii.1988 (genitalia slide no. 27138; BMNH); 1♀, same data but 750m, 26.ii–2.iii.1990 (genitalia slide no. 27139; BMNH).

DIAGNOSIS. This species is closely related to *C. chrysochoa* (Meyrick, 1886) which has a S.W. Pacific distribution — Fiji, Tonga, Niue I. and Samoa. The two species may be easily distinguished by the following major differences:

- (1) ventral surface of labial palpus much darker in *chrysochoa* than in *acinata*;
- (2) yellow blotch on forewing clearly separated into two in *acinata* but the separation not clearly defined in *chrysochoa*;
- (3) in the male genitalia *acinata* has a series of stout setae on the valva whereas *chrysochoa* has no setae of this type;
- (4) the saccus is broad in *acinata* but narrow and pointed in *chrysochoa*.

*Caloptilia protielli* (Deventer, 1904),  
comb. n.

(Figs 18, 49, 71)

*Gracilaria protielli* Deventer, 1904: 25, fig. 2(2).  
LECTOTYPE ♂, JAVA: Pekalongan (*Deventer*) (RNH, Leiden), here designated [examined].

*Gracilaria corollata* Meyrick, 1933: 362. Holotype ♀, JAVA: Seneng, iv.1932 (*Kalshoven*) (genitalia slide no. 27254; BMNH) [examined]. Synonymized by Meyrick, 1935: 599.



*Caloptilia (Timodora) elongata* Kumata, 1982: 98, figs. Holotype ♂ JAPAN: Nisinomate, Tanega-sima, 1.vii.1965 (genitalia slide no. Grc-1200; EIHU, Sapporo) [not examined].  
**Syn. n.**

**ADULT** (Fig. 18) ♂♀, 7.0–12.5 mm. Face dull yellowish white; head ochre-brown with purple reflection. Palpi of same colour as face, infuscated beneath. Fore and mid leg dark ochre-brown, fore coxa paler towards base, tarsi shining white with black apical ring on each segment; hind leg with coxa and femur yellowish white, femur darkened on distal three-fifths; tibia and tarsus ochre-yellow, apex of tibia and entire first tarsal segment somewhat infuscated above, a greyish apical band on each tarsal segment. Fore wing pale yellowish green, slightly purple suffused with ochre-brown along termen, at extreme apex and at base of costa; with minute blackish dots along costa and with several more prominent black spots, one at base of costa, largest in middle of costa, one on dorsum beside fold at two-fifths, and three to five along termen; cilia around apex grey with three black lines.

**GENITALIA** ♂ (Fig. 49). Tegumen strongly sclerotized and with adjacent row of elongate setae laterally. Subscaphium very short and weakly developed. Valva elongate, slightly broadened and upturned from one-quarter; with elongate patch of rather short setae along costal margin, and with a group of long setae at base of costa in addition to the usual elongate marginal setae. Vinculum nearly as long as valva, saccus very narrow and about half as long as entire vinculum. Aedeagus about three-fifths length of valva, slightly curved, without cornutus. 7th abdominal segment devoid of scales, 8th densely scaled, each segment with one pair of coremata; coremata with elongate hairs, anterior pair about twice length of posterior pair; medial apodeme of 7th sternite elongate, about half length of medial ridge of 8th tergite.

**GENITALIA** ♀ (Fig. 71). Apophyses anteriores slender, similar to apophyses posteriores. Lamella postvaginalis trapezoidal, weakly sclerotized, and with transverse semicircular ridges, connected with apophyses anteriores via an oval lobe; lamella antevaginalis absent. Antrum weakly sclerotized, cup-shaped; ductus bursae long and slender, entirely membranous; corpus bursae large, ovoid or ellipsoidal; with a pair of sickle-shaped signa that are asymmetrical in position.

**DISTRIBUTION.** India, Japan, Thailand, W. Malaysia, Java.

**BIOLOGY.** Larvae mining leaves of *Protium javanicum* (Burseraceae) (Deventer, 1904; Meyrick, 1937); *Rhus succedanea* Linn. and *R. sylvestris* Sieb. et Zucc. (Kumata, 1982); *Anacardium occidentale* Linn. (below) (Anacardiaceae).

**MATERIAL EXAMINED.** 2♂, INDIA: Assam, Margherita (*Doherty*) (genitalia slide no. 26837; BMNH); 1♀, C. THAILAND: Khao Yai NP, ca. 800m, 22–25.ii.1988 (*Bradley et al.*) (genitalia slide no. 27273; BMNH); 1♂, 2♀, W. MALAYSIA: Pahang, Sungei Baging, 25.ii.–13.iii.1986, ex *Anacardium occidentale* L. (*Tax. Expdn.*) (genitalia slide no. 26836; BMNH); 1♀ (paralectotype of *protiella*), JAVA: Pekalongan (*Deventer*) (RNH, Leiden); 1♀ (determined as *protiella* by Meyrick), JAVA: Telawa, vii.1933 (*Kalshoven*) (genitalia slide no. 27152; BMNH); 1♂, 1♀, JAVA: Yogyakarta, 12.vii.1978, ex *Anacardium occidentale* L. (*Soeprapto*) (genitalia slide nos 20680, 20787; BMNH).

**DIAGNOSIS.** *C. protiella* is very closely related to *iselaea* (below) — see the diagnosis of the latter species. The male genitalia of *protiella* are similar to those of *C. chrysochoa* (Meyrick, 1886) from Fiji, Tonga, Niue I. and Samoa, but the two species may be distinguished externally by the presence of a bright yellow blotch on the fore wing of *chrysochoa*.

**REMARKS.** Comparison of Kumata's (1982) original description of *elongata* with the holotype of *corollata* and with type material of *protiella* shows the species to be conspecific.

In addition to the material that we have examined, a further male and female paralectotype of *protiella* are in the RNH collection, Leiden (Nieukerken, pers. comm.).

*Caloptilia iselaea* (Meyrick, 1914), **comb. n.**

(Figs 19, 50, 72)

*Gracilaria iselaea* Meyrick, 1914: 286. LECTOTYPE ♀, SRI LANKA ('Ceylon'): Peradeniya, 14.iv.1914 (*Rutherford*) genitalia slide no. 27258; BMNH) [examined].

*Gracilaria hapalocharis* Meyrick, 1935: 599. Holotype ♀, JAVA: Bogor ('Buitenzorg'), 11.vi.1932 (*Voute*) (genitalia slide no. 27156; BMNH) [examined]. **Syn. n.**

**ADULT** (Fig. 19) ♂♀, 11.0–12.0 mm. Face yellowish white, slightly tinted with ochre; head ochre-grey with purple gloss. Palpi white; labial

palpus with second segment sparsely speckled with ochre-brown scales ventrally, apical segment with black ventral spots at base and at one-third and with black apex. Fore and mid leg dark ochre-brown, fore coxa much paler, tarsi shining white with black apical ring on each segment; hind leg with coxa and femur yellow, femur slightly infuscated in apical half, tibia and tarsus ochre-yellow, tibia and first tarsal segment slightly infuscated above, each tarsomere with grey apical band. Fore wing ochre-yellow with slight purple reflection; costal edge paler, with scattered minute dark fuscous spots; a brownish oblique band in middle of wing, sometimes not developed; with three prominent black spots: near base of costa close to fold, at middle of costa, on dorsum at two-fifths close to fold; apex of wing somewhat mottled with dark fuscous; cilia around apex of wing brown in proximal half, grey with three black lines in distal half.

**GENITALIA** ♂ (Fig. 50). Tegumen with a pair of peniculi, each with four stout setae at apex; caudal end of diaphragma with hairs and setae on ventral surface. Subscaphium very slender. Valva elongate, costal margin convex at two-thirds, elongate patch of short setae from near base to two-thirds of costa; hair-like setae at base of costa. Vinculum about four-fifths length of valva, saccus very narrow and about one-half length of entire vinculum. Aedeagus a little longer than valva, curved, greatly narrowed towards apex, apical third hook-shaped; without cornutus. 7th abdominal segment devoid of scales, 8th with scales, each segment with one pair of coremata; coremata with elongate hairs, anterior pair about 1.5 length of posterior pair; medial apodeme of 7th sternite slender, about one-half length of medial ridge of 8th tergite.

**GENITALIA** ♀ (Fig. 72). Apophyses slender and hook-shaped, anteriores a little shorter than posteriores. Lamella postvaginalis trapezoidal, lateral margins formed by infolding of longitudinally rugose surface; lamella antevaginalis absent. Antrum short; ductus bursae slender, elongate, posterior quarter much broader than anterior region; corpus bursae large, ovoid; with a pair of slender, hook-shaped signa that are symmetrical in position.

**DISTRIBUTION.** Sri Lanka, Thailand, W. Malaysia, Java, Brunei, Sulawesi, Fiji, Cook Is.

**BIOLOGY.** Larva mining leaves of *Spondias mangiferae* (Meyrick, 1914), *Spondias pinnata* (Meyrick, 1935) and *Spondias cytherea* Sonn. (below) (Anacardiaceae).

**MATERIAL EXAMINED.** 3♀, N.E. THAILAND: Chaiyaphum, Phu Khieo, 2-4.v.1986 (Allen); 1♀, THAILAND: Bangkok, 10m, 8.v.1988 (Allen); 1♂, W. MALAYSIA: Selangor, Serdang, 22.vi.1976, ex *Spondias cytherea* Sonn. (MARDI); 1♂, MALAYSIA: W. Pahang, Genting Tea Estate, 2000', 28.viii.1976 (Barlow) (genitalia slide no. 26813; BMNH); 2♂ (determined as *iselaea* by Meyrick), JAVA: Bogor ('Buitenzorg'), ex *Spondias pinnata*, 1929 (Leefmans); 1 ex. (determined as *iselaea* by Meyrick; abdomen missing), JAVA: Telawa, ii.1936 (Kalshoven); 1♂, 1♀, BRUNEI: Bukit Bedawan, 1700', LP 263, GR 343958, ridge dipterocarp forest, 20-24.iv.1988 (Robinson) (genitalia slide nos 26814, 27155; BMNH); 1♂, 1♀, INDONESIA: Sulawesi Utara, Dumoga-Bone NP, 200-300m, ii-iii.1985 (Project Wallace); 2♀, FIJI: Wakaya I., 13-15.viii.1974 (Robinson); 1♂, 1♀, COOK IS: Aitutaki, 14.iii.1975 (Maddison).

**DIAGNOSIS.** *C. iselaea* and *C. protietta* are very closely related, and both are quite similar in colour and in genital structure. The two species may be separated using the following features:

- (1) ground-colour of fore wing more yellow-tinted in *iselaea*, more green-tinted in *protietta*;
- (2) apical segment of labial palpus only partly black on ventral surface in *iselaea*, entirely black in *protietta*;
- (3) in the male genitalia a pair of peniculi present in *iselaea*, absent in *protietta*;
- (4) in the female genitalia the lamella postvaginalis bounded laterally by infolding of longitudinally rugose surface in *iselaea*, by an oval lobe in *protietta*.

**REMARKS.** The holotype of *hapalocharis* is labelled with the collecting date of June, not July as given in the original description (Meyrick, 1935). This specimen differs from the type series of *iselaea* in the absence of the prominent black spots on the fore wing. However, the two taxa match in all other respects and we consider them conspecific.

### *Caloptilia dicamica* sp. n.

(Figs 20, 51)

**ADULT** (Fig. 20) ♂, 9.0-9.5 mm. Face and head fuscous with purple reflection. Palpi white; labial palpus with black apical ring on second segment which is suffused ventrally with black on proximal three-quarters, third segment with black ring at one-quarter, apical half black



except for extreme tip; maxillary palpus with ends of the two terminal segments black. Fore and mid leg black with purple reflection, fore coxa yellowish white except for apical one-quarter, tarsi white with black apical ring on each segment, a black medial band on first tarsal segment; hind leg with coxa and femur yellowish white, a brown spot at apex of costa, femur black on apical half, tibia and tarsus white, slightly ochre-tinted, base and apex of tibia and apical ring on each tarsal segment black. Fore wing ochre-brown with purple reflection, evenly covered with irregular blackish strigulae which are especially dense on basal third of costa and at apex; a single brassy yellow blotch, also covered with some pale black strigulae, from one-third of costa to near apex and extending two-thirds breadth of wing and with a large black spot in the middle of its dorsal margin; cilia around apex of wing black with two pale bands, one white spot on apex of wing at base of cilia.

**GENITALIA** ♂ (Fig. 51). Tegumen with a pair of corniform peniculi which are nearly one-quarter length of valva; tuba analis very weakly sclerotized. Subscaphium not developed. Valva oar-shaped, slightly dilated medially, ventro-apical margin rounded with the usual elongate marginal setae. Vinculum nearly four-fifths length of valva, saccus very narrow with apex rounded, about one-half length of entire vinculum. Aedeagus four-fifths length of valva, cylindrical and straight; vesica slightly sclerotized on apical third; without cornutus. 7th and 8th abdominal segments devoid of scales, each with one pair of coremata; posterior pair of coremata with large spindle-shaped scales, about one third length of anterior pair which are composed of elongate hair-like scales; medial apodeme of 7th sternite slender, about three-fifths length of medial ridge of eighth tergite which has a pair of small blotches representing minute glandular pores.

**GENITALIA** ♀. Unknown.

**DISTRIBUTION.** Brunei.

**BIOLOGY.** Unknown.

**MATERIAL EXAMINED.** Holotype ♂, BRUNEI: Bukit Retak, LP 238, GR 873804, moss forest, 1365m, 1-4.v.1989 (Allen & Tuck) (genitalia slide no. 26812; BMNH). Paratypes, 2♂, data as holotype; 1♂, BRUNEI: Bukit Pagon, LP 308, upper montane forest, 5520', 15-20.ii.1982 (Robinson) (genitalia slide no. 27260; BMNH).

**DIAGNOSIS.** This species, with its unusual genital structure, is the only South-East Asian member of a species-group segregated as the subgenus *Rhadinoptilia* by Kumata (1982). It may be readily distinguished from the other known *Rhadinoptilia* species by the much greater area of dark ochre-brown in the fore wing. The male genitalia of *dicamica* are similar to those of *C. (R.) camphorae* Kumata, 1982, from Japan, but may be easily distinguished from the latter by the lack of a round lobe near the middle of the costa of the valva.

**REMARKS.** To date, five species are recognised as comprising the subgenus *Rhadinoptilia*: *mastopis* (Meyrick, 1918), from Assam; *bipunctata* Kumata, 1982, from Japan; *camphorae* Kumata, 1982, from Japan; *sassafraticola* Liu & Yuan, 1990, from SE China; and *dicamica*. We have examined the six specimens determined as 'mastopis' in the BMNH collection. All are from Bombay (Mahabaleshwar), and collected from 1929 to 1930. All differ in colour pattern from the holotype of *mastopis* and are referable instead to *bipunctata*. They include the male example (genitalia slide no. 14765) dissected by Kuroko and examined by Kumata as an example of *mastopis*. Kumata differentiated *bipunctata* from what he took to be *mastopis* by the shorter peniculus in the male genitalia. In fact the peniculus in the Bombay *bipunctata* is only one-third the length of the valva, similar to its length in Japanese *bipunctata* (Kumata, 1982: fig. 40A).

*Caloptilia aeolospila* (Meyrick, 1938),  
**comb. n.**

(Figs 25, 52)

*Gracilaria aeolospila* Meyrick, 1938: 21. Holotype ♂, CHINA: Yunnan, Lijiang ('Likiang'), 3200m, vi.1934 (Höne) (genitalia slide no. 26764; BMNH) [examined].

**ADULT** (Fig. 25) ♂, 17.0 mm. Face white mottled with brown; head brown. Palpi white, ventrally dark brown; labial palpus with rough apical tuft on ventral surface of second segment consisting of ochre-yellow scales with brown tips; apex of third segment white. Fore legs missing; mid leg brown, evenly speckled with ochre-yellow, first tarsal segment with white ring at one-third, other tarsomeres with white bases; hind leg with yellow coxa and femur sparsely speckled with dark brown; tibia and tarsus ochre-yellow, somewhat infuscated above at apex of tibia and on basal two-thirds of first tarsal segment, each tarsomere with black apical ring. Fore wing with



brassy yellow ground-colour evenly speckled with brown, with white fasciae and spots, sometimes edged with dark fuscous, forming a complicated fine pattern; cilia round apex pale brassy yellow obscurely barred or mixed with brown.

**GENITALIA** ♂ (Fig. 52). Subscaphium moderate. Valva abruptly dilated in distal half, apex almost truncated, costo-apical corner acute, ventro-apical corner rounded, both densely covered with the usual elongate marginal setae; with a row of short, stout setae inserted along ventral margin to near base. Vinculum broad, apex blunt, nearly three-quarters length of valva. Aedeagus almost as long as valva, distal half sinuate; broadly dilated near apex and with dense, fine corniform spines; without cornutus. 7th abdominal segment devoid of scales, 8th sparsely scaled, each segment with one pair of coremata; coremata with elongate scales, anterior pair twice length of posterior pair; medial apodeme of seventh sternite slender, half length of medial ridge of 8th tergite.

**GENITALIA** ♀. Unknown.

**DISTRIBUTION.** China (south).

**BIOLOGY.** Unknown.

**MATERIAL EXAMINED.** Holotype only.

**DIAGNOSIS.** This species, and *jelita* (below) are representatives of a distinctive species-group of *Caloptilia* that share the following characters:

- (1) second segment of labial palpus with rough ventral tuft of scales at apex;
- (2) fore wing yellow with complicated pattern composed of white or dark brown fasciae and/or spots;
- (3) aedeagus with dilated apex covered with short corniform spines (carinae). See the diagnosis of *jelita* for differentiation from that species.

**REMARKS.** *Caloptilia (Povolnya) striolata* Liu & Yuan, 1990, was described from two females from Fujian, SE China. We suspect it may represent the opposite sex of *aeolospila*, known only from the male holotype. Further material is needed to test this possibility.

In addition to *aeolospila*, *striolata* and *jelita* we have seen limited material of a further eight unnamed species referable to this species-group. They are all from high altitudes: India (Uttar Pradesh — Nainital, Khasi Hills); Nepal; Thailand (Doi Inthanon); W. Malaysia (Gunung Lawit, Gunung Brinchang) and Sulawesi Utara (Gunung Muajat).

### *Caloptilia jelita* sp. n.

(Figs 26, 53, 73)

**ADULT** (Fig. 26) ♂♀, 15.5–16.0 mm. Face white; head yellow, vertex with some fuscous medially. Palpi yellowish white, black ventrally except at extreme tips; labial palpus with rough apical tuft on second segment ventrally, yellowish white mottled with fuscous and black. Fore and mid leg black, coxae paler with white blotches near base and in middle, first tarsal segment with white ring at one-quarter, remaining tarsal segments greyish white at base; hind leg with coxa and femur brassy yellow, black spot at base of coxa, distal half of femur black, tibia and tarsus ochre-yellow, somewhat infuscated above at apex of tibia and on basal half of first tarsal segment, each tarsomere with black apical ring. Fore wing with brassy yellow ground-colour, white fasciae and spots mostly edged with black and dark ochre-brown forming a complicated pattern; cilia around apex pale brassy yellow obscurely barred or mixed with brown.

**GENITALIA** ♂ (Fig. 53). Subscaphium slender, weakly sclerotized. Valva gradually dilated towards apex, termen almost truncated; costo-apical corner blunt, ventro-apical corner rounded, both densely covered with the usual elongate marginal setae. Vinculum about four-fifths length of valva, apex somewhat acute. Aedeagus 1.2 x length of valva, straight, slightly constricted medially; apex broadly dilated and covered with dense corniform spines (carinae); without cornutus. 7th and 8th abdominal segments with sparse scaling only on 8th, each segment with one pair of coremata; coremata with elongate hairs, anterior pair about twice length of posterior pair; medial apodeme of 7th sternite slender, only about one-third length of medial ridge of eighth tergite.

**GENITALIA** ♀ (Fig. 73). Apophyses anteriores slender, similar to apophyses posteriores. Lamella postvaginalis and antevaginalis not differentiated; eighth sternite with bottle-shaped sterigma with ostium at apex, sterigma surrounded by a narrow ring-shaped sclerite with transverse wrinkles posteriorly. Antrum strongly sclerotized, cylindrical, as long as apophyses anteriores; ductus bursae slender, elongate, entirely membranous; corpus bursae ovoid; with a pair of corniform signa that are symmetrical in position but one only one-third the length of the other.

**DISTRIBUTION.** W. Malaysia.

BIOLOGY. Unknown.

MATERIAL EXAMINED. Holotype ♂, W. MALAYSIA: Cameron Highlands, Gunung Brinchang, 1980m, 23–31.x.1989 (*Robinson & Tobin*) (genitalia slide no. 27125; BMNH). Paratypes, 2♀, data as holotype (genitalia slide no. 27126; BMNH).

DIAGNOSIS. *C. jelita* resembles *aeolospila* (above) superficially, but may be easily distinguished by the male genitalia: the costo-apical corner of the valva is sharper and more protruded in *aeolospila* than in *jelita*; the row of short, stout setae along the ventral margin of the valva of *aeolospila* is absent in *jelita*. The female genitalia of *jelita* may be distinguished from those of *striolata* (see above) by the shape of the sterigma — smooth and bottle-shaped in *jelita* and deep inverted bowl-shaped with transverse wrinkling in *striolata*.

*Caloptilia selimpat* sp. n.

(Figs 21, 30, 54)

ADULT (Fig. 21) ♂, 11.5–13.0 mm. Face white, lower lateral margins black; head white. Palpi white; labial palpus with rough tuft on second segment which is black except at apex, third segment with black spots at base and at one-third, a black ring at two-thirds; maxillary palpus with second segment and basal half of third black ventrally. Fore and mid leg black, fore coxa white at extreme base, a few white spots on femora and tibiae; tarsi white, extreme base of first segment and distal quarter of all segments black; hind leg with coxa and femur white, a small spot at base of femur black, distal three-fifths of femur black, tibia and tarsus white, tibia and base of first tarsal segment infuscated above, distal quarter of each tarsomere black. Fore wing black, a white transverse band extending from one-third to near apex of wing, basal sixth of band blackened on costa anterior to fold but separated from black base of wing by a white line; transverse band irregularly marked by black fasciae and spots, suffused near apex with two patches of ochre-yellow; white spot at one-sixth on dorsum close to fold; cilia around apex dark fuscous with a single white line, mixed with white on termen.

GENITALIA ♂ (Figs 30, 54). Subscaphium slender, swollen medially, narrow T-shaped at extreme base. Valva with costa strongly curved, costo-apical corner sharp, ventro-apical corner rounded. Vinculum tapering to pointed saccus, about as long as valva. Aedeagus needle-like,

apex greatly narrowed, about five-sixths length of valva, without cornutus. 7th and 8th abdominal segments covered by dense, large, broad scales, only 8th segment with a pair of coremata; coremata with elongate spindle-shaped scales, about 1.7 x length of valva; 7th sternite reduced to a narrow bar at anterior margin, medial apodeme absent (Fig. 30).

GENITALIA ♀. Unknown.

DISTRIBUTION. W. Malaysia.

BIOLOGY. Unknown.

MATERIAL EXAMINED. Holotype ♂, W. MALAYSIA: Cameron Highlands, Gunung Brinchang, 1980m, 23–31.x.1989 (*Robinson & Tobin*) (BMNH). Paratypes, 2♂, data as holotype (genitalia slide no. 27263; BMNH); 1♂, data as holotype but 15–23.viii.1986 (*Robinson*) (genitalia slide no. 26819; BMNH).

DIAGNOSIS. This species represents a distinctive and peculiar development within *Caloptilia*. The wing pattern is unlike that of other members of the genus, with a black ground colour, broad white transverse band, and a complicated pattern of fasciae and spots. The seventh and eighth abdominal segments are membranous but densely covered by broad scales; there is only a single pair of coremata, these on the eighth segment. Similar loss (?) of a pair of coremata occurs in *teucra* (see the diagnosis for that species, below) and *baringi* (above) but in the latter species it is the coremata from the eighth segment that are lost.

REMARKS. We are aware of specimens that may represent a further three species closely related to this one. Their wing patterns and genital structure are similar to but not identical with *selimpat*; all are male and each 'species' is represented by only a few specimens. All are from montane or lower montane forest in W. Malaysia or Brunei (Gunung Brinchang — same locality and date as *selimpat*, Gunung Hijau and Maxwell's Hill in W. Malaysia, and Bukit Retak in Brunei). Specimens from 'Gunung Hijau, Perak' were collected at the turn of the century by William Doherty. This locality may be identical with that collected by Robinson & Tobin in 1989, the Gunung Hijau that forms a shoulder at about 1100 m on the massif known collectively as Maxwell's Hill or Bukit Larut near Taiping in Perak.



*Caloptilia teucra* (Meyrick, 1933), **comb. n.**

(Figs 22, 31, 55)

*Gracilaria teucra* Meyrick, 1933: 363. LECTOTYPE ♂, JAVA: 27.x.1931, ex *Bridelia* (*Kalshoven*) (genitalia slide no. 27157; BMNH), here designated [examined].

*Gracilaria teucra*; Meyrick, 1934: 474 [description amended].

ADULT (Fig. 22). ♂, 7.0–8.0 mm. Face white; head white with pale brown streaks on occiput. Palpi white flecked with brown on outer surface; labial palpus with brown ventral spot at apex of second segment and subapically on third; maxillary palpus brown ventrally at apices of terminal and penultimate segments. Fore and mid legs ochreous speckled with darker brown proximally, tarsomeres white, on mid leg each with apical brown spot dorsally; hind legs white speckled with brown, conspicuous large brown spot on outer surface of femur, tarsomeres tipped with brown. Fore wing ochreous with dark purple-brown speckling; narrow oblique yellowish white transverse fascia at one-third spotted with very dark scales at margins; small yellowish white spot on tornus; ill-defined yellowish strigulae on costa at five-sixths and close to apex; cilia dull ochreous with two ill-defined darker lines.

GENITALIA ♂ (Figs 31, 55). Subscaphium slender. Valva distinctly dilated towards apex, ventro-apical corner rounded, with the usual long marginal setae. Vinculum three-quarters length of valva, distinctly narrowed towards apex. Aedeagus slender, needle-like, almost as long as valva, without cornutus. 7th and 8th abdominal segments sparsely covered with elongate scales, eighth segment (only) with a pair of coremata; 7th sternite strongly reduced, a small sclerite; 8th tergite membranous; coremata with elongate hairs (Fig. 31).

GENITALIA ♀. Unknown.

DISTRIBUTION. Java.

BIOLOGY. Larvae mining leaves of *Bridelia* (Euphorbiaceae) (Meyrick, 1933).

MATERIAL EXAMINED. 1♂ (head and abdomen missing — paralectotype of *teucra*), JAVA: 24.x.1931, ex 'Daoen gandri' [*Bridelia*] (*Kalshoven*) (RNH, Leiden); 1♂ (identified by Meyrick as *teucra*), JAVA: Buitenzorg, 26.x.1933, ex 'Daoen kandri' [*Bridelia*] (*Kalshoven*) (RNH, Leiden).

DIAGNOSIS. *C. teucra* is superficially similar to 'species A' and *oxydelta* (see below); however,

in neither of these species does the narrow yellowish fascia completely cross the fore wing as in *teucra*. It is distinguished by the presence of only one pair of coremata, these arising from the eighth segment. The only other South-East Asian *Caloptilia* with coremata restricted to the eighth segment is *selimpat* (above). However, the two species are only distantly related; in *teucra* the reduction of the sclerotization of the 7th and 8th abdominal segments compared with the preceding ones is not as advanced as in other *Caloptilia*, including *selimpat*; the 7th sternite is retained as a vestigial small sclerite but the 8th tergite is membranous as in other *Caloptilia*. Scaling of the 7th and 8th segments is modified, with only sparse scales that are more elongate than those on the preceding segments; in *selimpat* both segments are also scaled but the scales are more dense and of a different form, large and broad.

REMARKS. The genital features of *teucra* are somewhat intermediate between *Gracilaria* and *Caloptilia* (*sensu* Kumata, 1982), modification of the terminal abdominal segments being less marked than in most, if not all *Caloptilia* species. Its systematic position must therefore remain doubtful in the absence of adequate material for comparison.

*Caloptilia* species A

(Figs 23, 74)

[*Gracilaria oxydelta*; Meyrick, 1936: 38. Misidentification.]

DISTRIBUTION. Java.

BIOLOGY. Larvae mining leaves of *Flueggea virosa* (Euphorbiaceae) (Meyrick, 1936).

MATERIAL EXAMINED. 2♀, (determined as 'Gracilaria oxydelta' by Meyrick), JAVA: Tellowa, vii.1935 (*Kalshoven*) (genitalia slide no. 27279; BMNH).

REMARKS. *Caloptilia oxydelta* (Meyrick, 1908: 831) was described (as *Gracilaria oxydelta*) from two female syntypes from India (north Coorg) that are now in the BMNH collection. We here designate the female labelled INDIA: N. Coorg, 3500', 24.v.1907 (*Newcome*) as LECTOTYPE. The two female specimens subsequently identified and published by Meyrick as 'oxydelta' from Java are clearly not that species and exhibit the following differences from the Indian syntypes of *oxydelta*: fore wing uniformly violet-fuscous in Javanese specimens, violet-fuscous irrorated with dark fuscous in *oxydelta*;



triangular yellow blotch on fore wing extending close to fold in Javanese specimens, always crossing the fold in *oxydelta*.

In the absence of further material, including males, of the Javanese species, its identity must remain in doubt.

*Caloptilia? leucolitha* (Meyrick, 1912),  
comb. n.

(Fig 24)

*Gracilaria leucolitha* Meyrick, 1912: 30. Holotype ♂ (abdomen missing), AUSTRALIA: [Northern Territory], Darwin ('Port Darwin'), 1910 (Dodd) (BMNH) [examined].

[*Gracilaria platycosma*; Meyrick, 1930: 582; Fletcher, 1933: 62 (biology). Misidentification.]

DISTRIBUTION. Sri Lanka, India, Java, Bali, Australia.

BIOLOGY. Larvae 'rolling leaves' [prior to pupation — a miner in early instars?] of *Litsea glutinosa* (Lauraceae) (Meyrick, 1930; Fletcher, 1933 — as *platycosma*); on *Litsea chinensis* (Meyrick MS notebook, BMNH; this record may refer to the specimens bred by Kalshoven from Java).

MATERIAL EXAMINED. 2♂ (identified by Meyrick as '*Gracilaria platycosma*'), SRI LANKA ('Ceylon'): Peradeniya, vii.1928, bred from *Litsea glutinosa* (Hutson); 1 ex. (abdomen missing), INDIA: N. Coorg, Dibidi, vi.1913 (N[ewcome]); 3 ex. (abdomens missing; identified by Meyrick as '*G. platycosma*'), JAVA: Telawa, vi.1935, bred (Kalshoven); 1 ex. (abdomen missing), BALI: 1896 (Doherty).

DIAGNOSIS. See 'Remarks'.

REMARKS. Certainty as to the identity of the Javanese and Balinese specimens listed above is impossible as all their abdomens are missing. However, their external features match well the holotype of *leucolitha*. The male abdominal structure of *leucolitha*, based on the two specimens from Sri Lanka (above), is remarkable, and makes the generic placement of this species uncertain. The 7th and 8th segments are membranous, like *Caloptilia*; the 7th is devoid of scales but the 8th has sparse ovoid scales; each segment has one pair of coremata. The anterior pair (from the 7th segment) are enormous, extending almost the full length of the abdomen, whereas the posterior pair are very short. The medial apodeme of the 7th sternite is well developed, roughly equal in length to the medial ridge of the eighth tergite.

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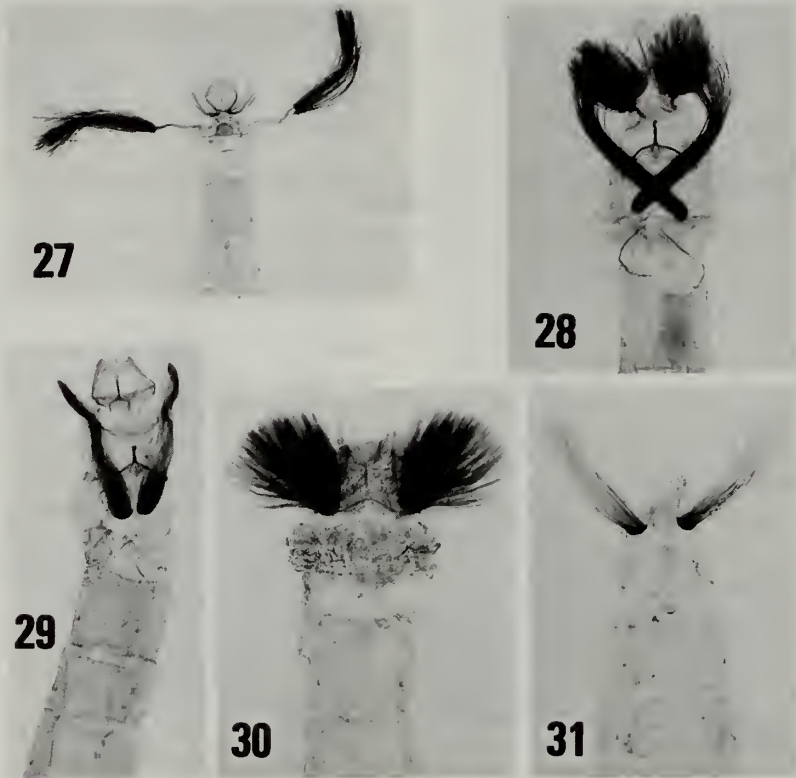
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## INDEX

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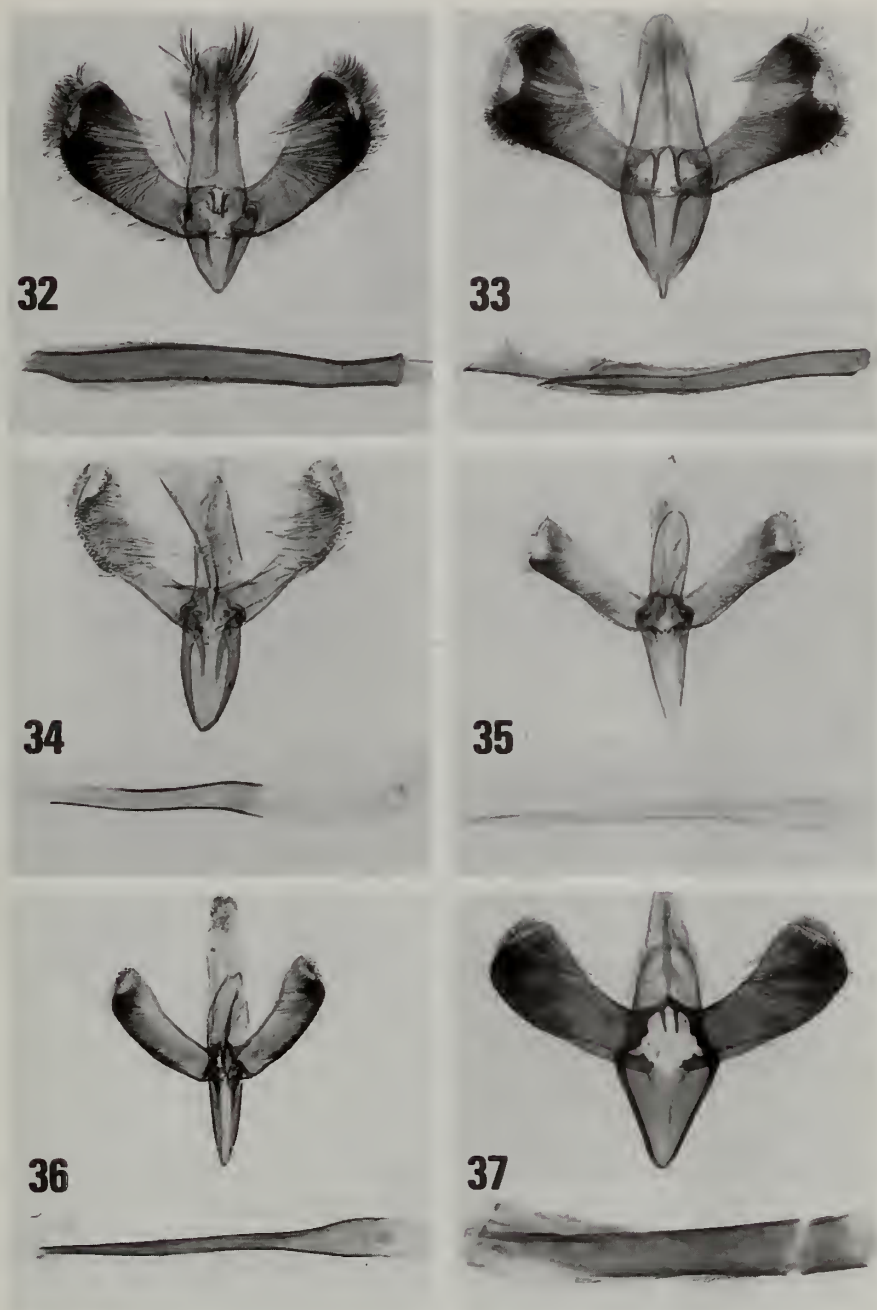
Invalid names are in *italics*; principal references are in **bold**.

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| <p>acericola Kumata 11<br/>           acinata sp.m. <b>18</b><br/>           acrotherma Meyrick 16<br/>           aeolospila Meyrick <b>22</b><br/> <i>Antiolopha</i> 2<br/>           ariana Meyrick <b>11</b><br/>           aurifasciata Kumata <b>16</b></p> <p>baringi sp.n. <b>12</b><br/>           bipunctata Kumata 22</p> <p>Caloptilia 1, 2<br/>           camphorae Kumata 22<br/>           Cecidoptilia 3<br/>           chrysochoa Meyrick 19<br/> <i>Coriscium</i> 2<br/>           corollata Meyrick 19</p> <p>dicamica sp.n. <b>21</b><br/>           dogmatica Meyrick 8</p> <p><i>elongata</i> Kumata 19<br/>           emas sp.n. <b>12</b><br/>           etiolata sp.n. <b>10</b></p> <p>flavida Liu &amp; Yuan <b>10</b></p> | <p>Gracillaria 2, 4</p> <p><i>hapalocharis</i> Meyrick 20<br/> <i>heliciae</i> Kumata 11<br/>           hemiconis Meyrick <b>14</b></p> <p>iorphna Meyrick <b>13</b><br/>           isclaca Meyrick <b>20</b><br/>           isochrysa Meyrick 11</p> <p>jelita sp.n. <b>23</b></p> <p>leucolitha Meyrick <b>25</b></p> <p>mastopis Meyrick 22<br/>           Minyoptilia 3</p> <p>nomurai sp.n. <b>8</b></p> <p><i>Ornix</i> 2<br/>           oxydelta Meyrick 25</p> <p><i>perseella</i> Kumata 18<br/>           Phylloptilia 3</p> | <p>platycosma Meyrick 25<br/> <i>Poeciloptilia</i> 2<br/>           Povolnya 2<br/>           prosticta Meyrick 16<br/>           proticella Deventer <b>19</b></p> <p>Rhadinoptilia 3<br/> <i>rhaptoecrossa</i> Meyrick 14</p> <p>sassafracicola Liu &amp; Yuan 22<br/>           scacodesma Meyrick <b>17</b><br/>           selimpat sp.n. <b>24</b><br/>           soyella Deventer <b>15</b><br/>           species A <b>25</b><br/>           sphenocrossa Meyrick <b>9</b><br/>           Sphyrophora 3<br/>           stigmatella F. 3<br/>           striolata Liu &amp; Yuan 23<br/>           syrphetias Meyrick <b>18</b></p> <p>tangkai sp.n. <b>14</b><br/>           teucra Meyrick <b>24</b><br/>           theivora Walsingham 7<br/>           Timodora 3</p> <p><i>zopherotarsa</i> Meyrick 18</p> |
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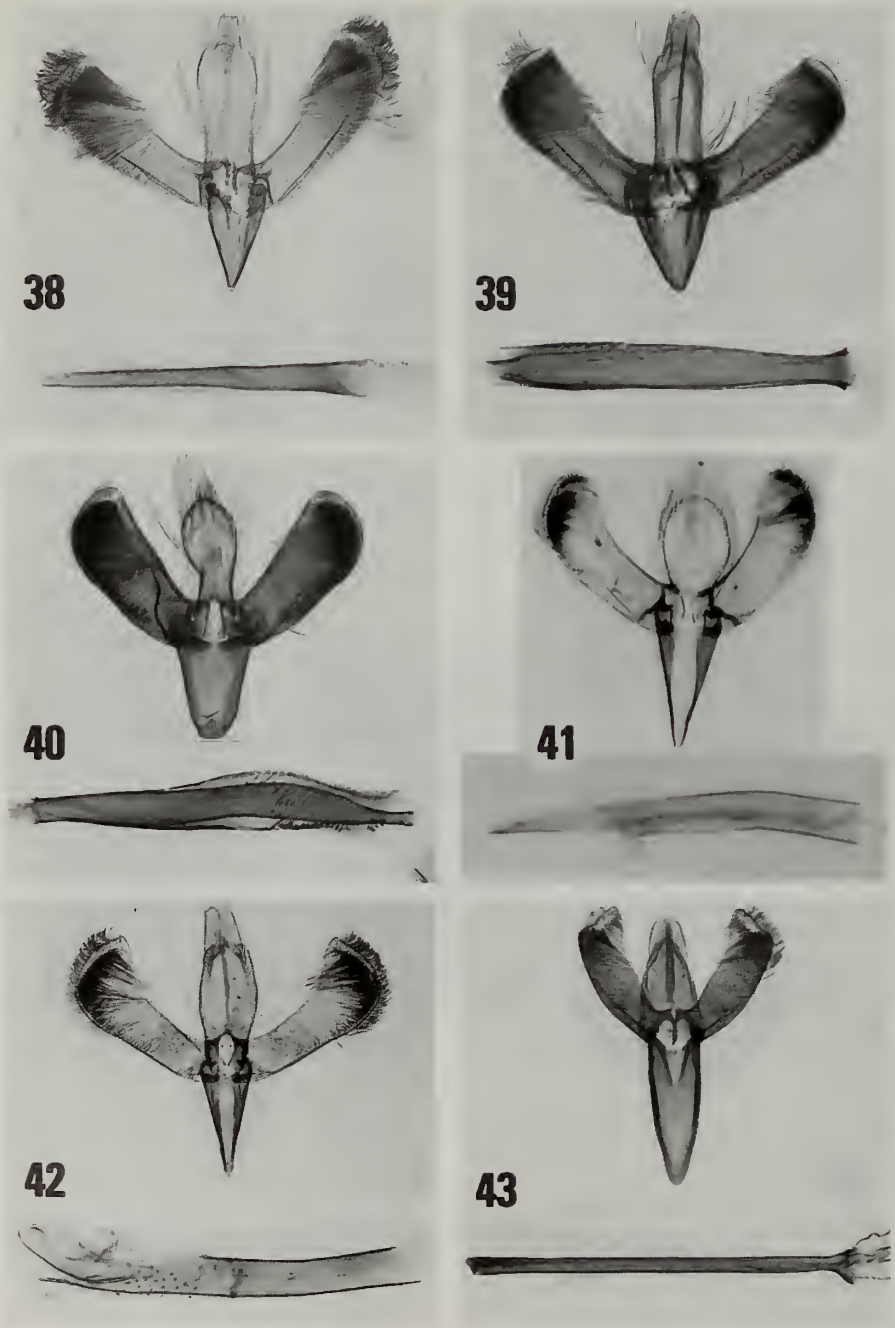


**Figs 27–31.** Abdominal apex and coremata of male *Caloptilia* spp.: 27, *theivora*, Brunei; 28, *ariana*, Sabah; 29, *soyella*, China; 30, *selimpat*, paratype, W. Malaysia; 31, *teucra*, Java.





**Figs 32–37.** Male genitalia and aedeagus of *Caloptilia* spp.: 32, *theivora*, Brunei; 33, *nomurai*, holotype, Brunei; 34, *dogmatica*, India; 35, *sphenocrossa*, holotype, Java; 36, *etiolata*, holotype, W. Malaysia; 37, *flavida*, C. Thailand.

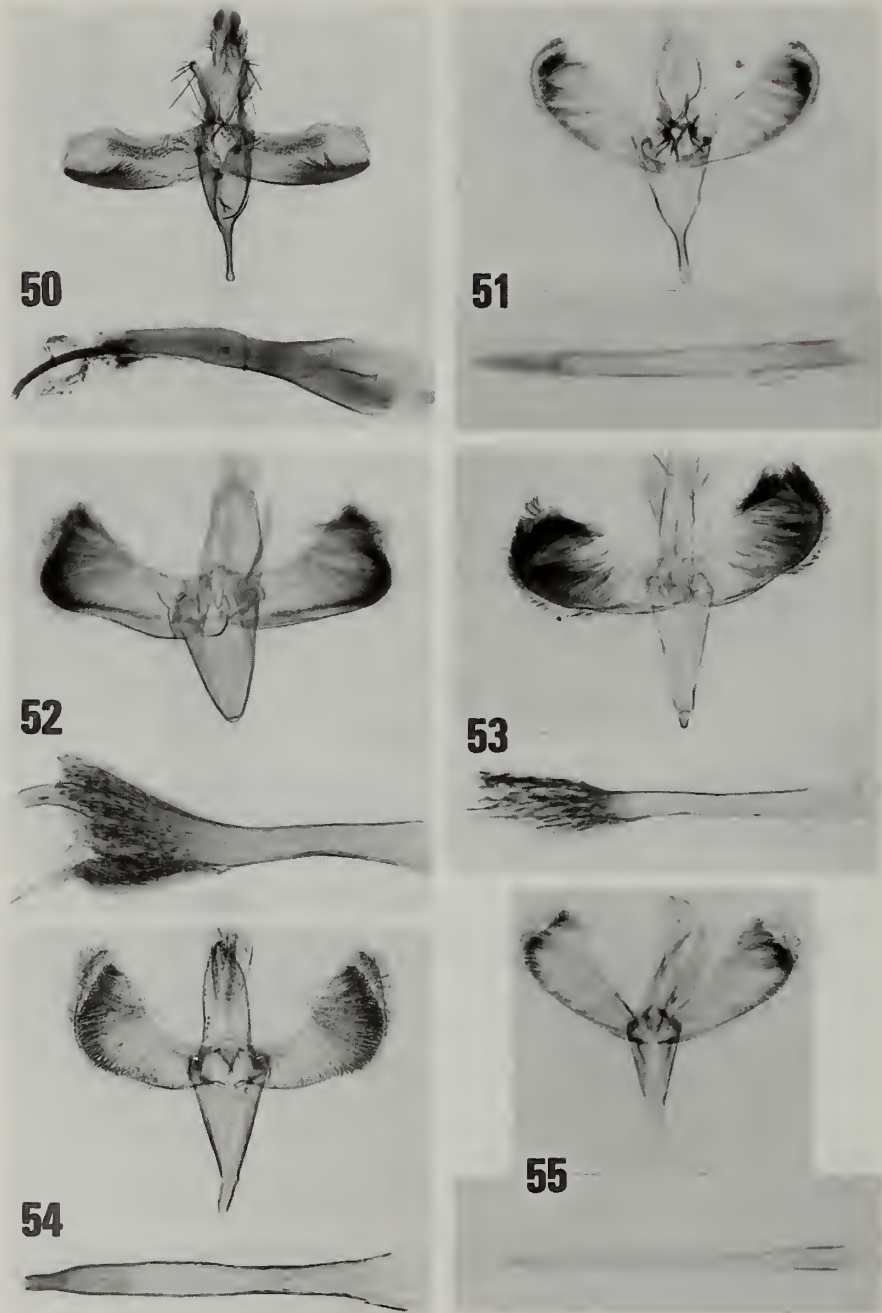


Figs 38–43. Male genitalia and aedeagus of *Caloptilia* spp.: 38, *ariana*, Sabah; 39, *emas*, holotype, W. Malaysia; 40, *baringi*, holotype, Brunei; 41, *iorphna*, lectotype, Java; 42, *tangkai*, holotype, N. Thailand; 43, *hemiconis*, Bali.



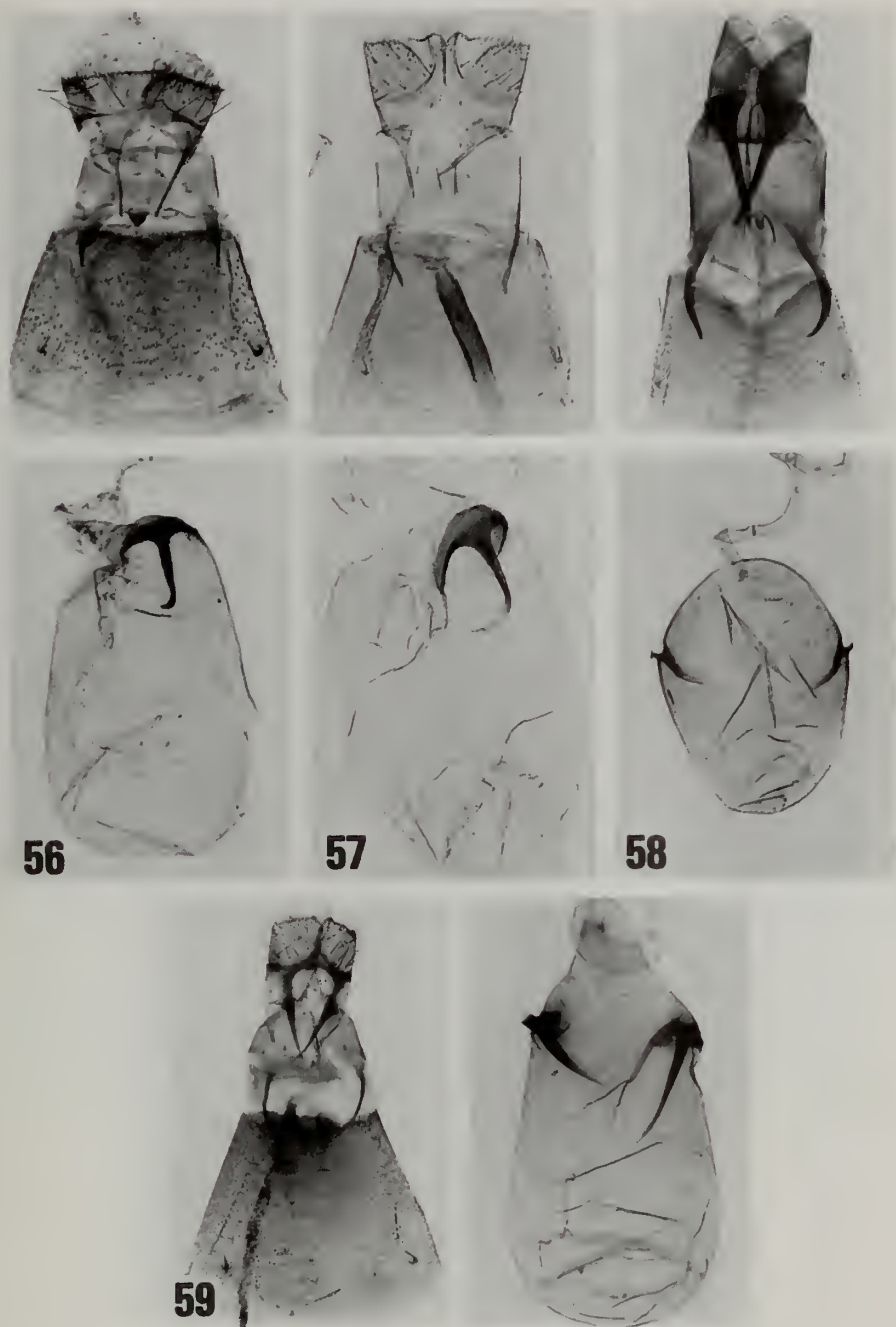


Figs 44–49. Male genitalia and aedeagus of *Caloptilia* spp.: 44, *soyella*, China; 45, *aurifasciata*, W. Malaysia; 46, *scaeodesma*, W. Malaysia; 47, *syrphetias*, paralectotype, Sri Lanka; 48, *acinata*, paratype, C. Thailand; 49, *protiella*, W. Malaysia.



Figs 50–55. Male genitalia and aedeagus of *Caloptilia* spp.: 50, *iselaea*, W. Malaysia; 51, *dicamica*, paratype, Brunei; 52, *aeolospila*, holotype, China; 53, *jelita*, holotype, W. Malaysia; 54, *selimpat*, paratype, W. Malaysia; 55, *teucra*, Java.



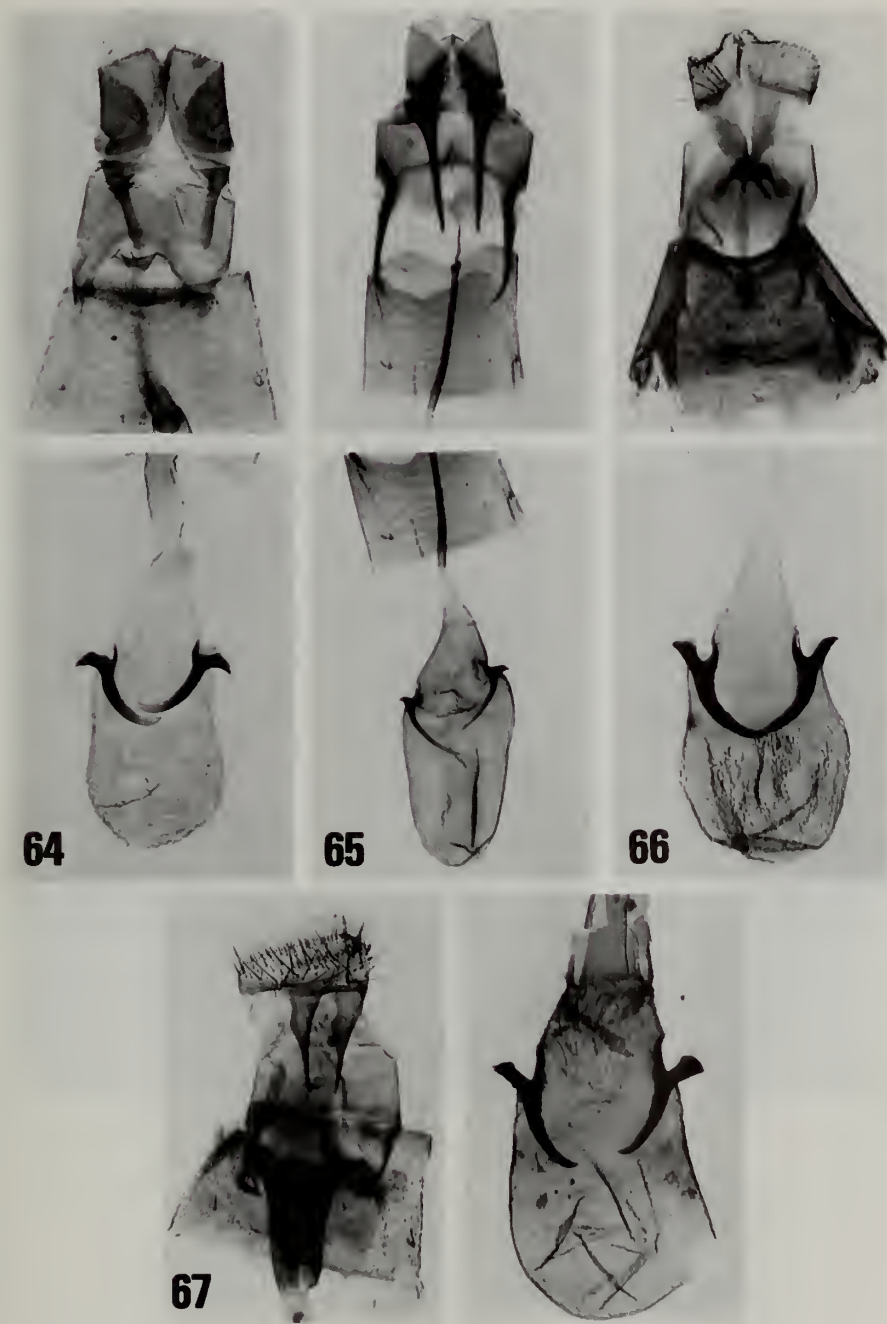


Figs 56–59. Female genitalia — ovipositor and corpus bursae — of *Caloptilia* spp.: 56, *theivora*, Sri Lanka; 57, *nomurai*, paratype, Brunei; 58, *dogmatica*, paralectotype, Sri Lanka; 59, *sphenocrossa*, W. Malaysia.



**Figs 60–63.** Female genitalia — ovipositor and corpus bursae — of *Caloptilia* spp.: 60, *etiolata*, paratype, W. Malaysia; 61, *flavida*, C. Thailand; 62, *ariana*, C. Thailand; 63, *baringi*, paratype, Sabah.

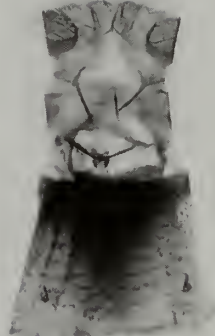




**Figs 64–67.** Female genitalia — ovipositor and corpus bursae — of *Caloptilia* spp.: 64, *iorphna*, Java; 65, *hemiconis*, India; 66, *soyella*, India; 67, *aurifasciata*, Hong Kong.



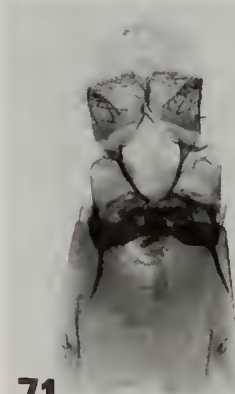
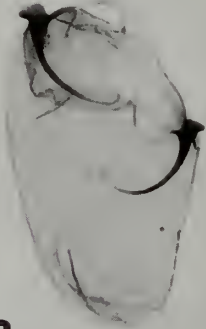
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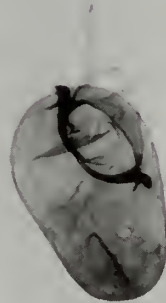
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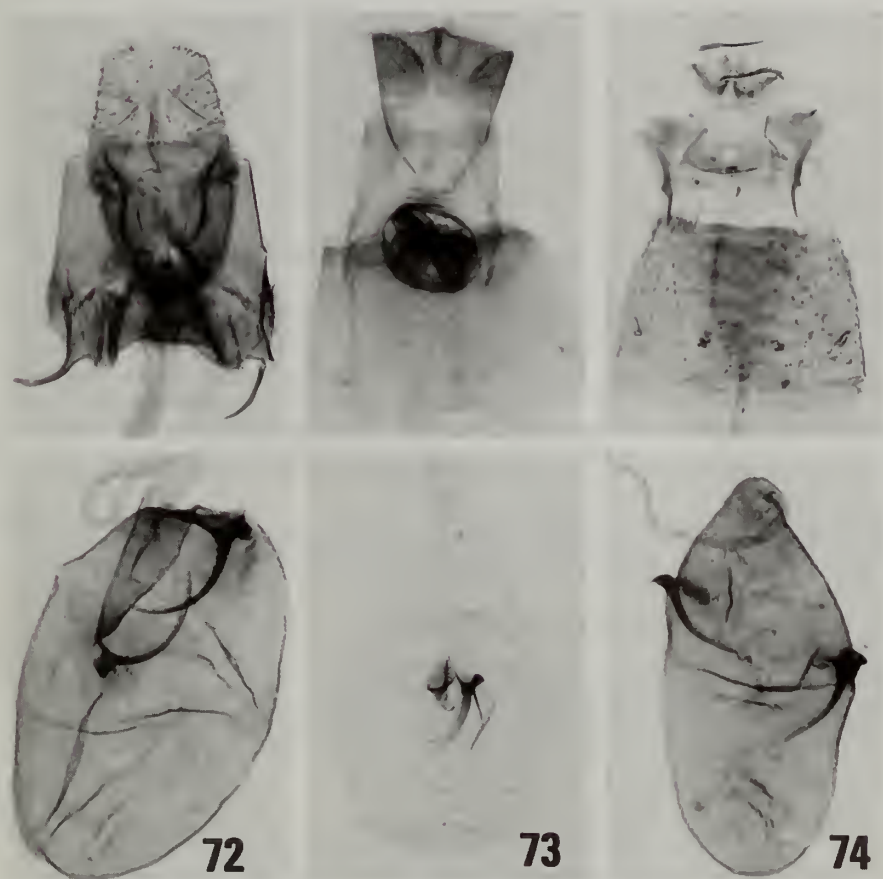
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Figs 68–71. Female genitalia — ovipositor and corpus bursae — of *Caloptilia* spp.: 68, *scaeodesma*, Anambas Is; 69, *syrphetias* (paralectotype of *zopherotarsa*), China; 70, *acinata*, paratype, C. Thailand; 71, *protielli* (holotype of *corollata*), Java.



Figs 72-74. Female genitalia — ovipositor and corpus bursae — of *Caloptilia* spp.: 72, *iselaea*, Brunei; 73, *jelita*, paratype, W. Malaysia; 74, species A, Java.